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RAPID TRANSIT IN NEW YORK.

There is every prospect that at the election next week there will be a large majority in favor of the rapid transit measure for New York City. In the report of Chief Engineer Parsons and in the address issued to voters by the Rapid Transit Commission, strong grounds are taken in favor of the use of electricity for a motive power, so that there is no question as to the adoption of electric traction in the final plans. That there should have existed any doubt on the subject has been due to the opponents of the measure, who have not hesitated to pronounce that method as only in the experimental stage and otherwise discredit it, notwithstanding the success of the electrical underground roads of London and the entire engineering feasibility of electric traction on roads much more extensive than the proposed ones. While the successful carrying out of this great undertaking on the lines indicated will be of incalculable value to New York, it will also doubtless result in the adoption of the same system in other cities, and in other directions also cause a greater development of electric traction.

LIGHT FROM ELECTRIC OSCILLATIONS.

Elsewhere we reprint an article by Prof. Ebert which is of interest on account of giving some quantitative results in regard to the energy expended in producing light by means of alternating currents of high frequency. The experiments referred to do not seem to add anything new to the knowledge we have received of high frequency phenomena from the magnificent work of Tesla, but the simple apparatus described places it within reach of the ordinary experimenter to enter on the study of this most interesting subject. As will be seen, the author confines himself to phosphorescent effects, and to the determination of the efficiency of what he calls the "luminescent lamp." The result is startling, as it was found that the high frequency lamp consumed from 1,500 to 2,000 times less energy than the amyl acetate standard with which the comparison of light was made. To be sure, the amount of light produced by the luminescent lamp experimented with was insignificant, but then the author does not intimate that more powerful effects cannot be attained. The author refers to the difficulty of distributing high frequency currents and makes the suggestive comment that this to a certain extent may be obviated by having the necessary transforming apparatus in the base of the lamp, as the capacities and inductances necessary are small.

THE PHILADELPHIA ELECTRIC RAILWAY SYSTEM.

In this issue we give another installment of Prof. Hering's engineering account of the electric railway system of the Philadelphia Traction Company. As this plant is probably the most thorough one in all of its engineering details yet installed, our readers interested in the subject will do well to make a careful study of the article. It will be noted that each power house has a test room thoroughly equipped with the necessary instruments, and that there is a special car fitted with instruments to make tests along the line. These are commendable features and show an intention of not trusting to the usual hap-hazard methods to keep the plant in an efficient condition, and the thorough system of testing circuits and connections is further evidence of this, implying that the problem has been worked out in a systematic manner. Some power houses that have a fair equipment of testing apparatus might as well be without them on account of the absence of such a system. Indeed, in many cases there is little doubt but that the instrument equipment is regarded merely in the light of a scientific exhibit whose greatest service is to impress the public with the mysteries they represent, and heighten its regard for those who are supposed to understand

them. Mr. Fritz Uhlenhaut, the chief engineer of the company, has demonstrated that he is thoroughly well qualified for the position he has so ably filled, and when we learn that he was formerly connected with the Brooklyn Edison Illuminating station, it is not difficult to understand why so much stress has been laid upon electrical points usually entirely neglected in electric street railway practice.

COSMIC ELECTRICITY.

Dr. H. R. Rogers in a pamphlet advances the theory that the solar system is a vast dynamo, and that light and heat are the result of an electric current between the earth and the sun. According to his theory, the sun and earth revolving on their axes and in their orbits, constitute a vast "terra-solar" electrical machine, to the action of which are due the currents which incessantly come from the sun to the earth. Extending the principle of the dynamo from the solar to the celestial field, he considers it a legitimate inference that the stellar worlds, whirling in space, also evolve between them electrical currents in great cosmical circuits. The author remarks that "given motion and magnetism, and "they can be used in explanation of all observed phenomena of "inorganic matter, from the cohesion of the particles in a clod to "the order of the solar system." As the planets move the only assumption necessary on these premises is that the sun is a magnet. What an infinity of speculations could be built up on such logic! The doctor is taken seriously, however, by a newspaper writer who exclaims : "So powerful does this theory of electricity as the direct "agent in the application of primal force compel the imagination, "that its utmost flights on the wings of less developed theories are "as nothing to what may be expected of it if science generally "adopts electricity as the general agent of the application of cos-"mic force. Instead of such crude vehicles of imagination as pro-"jectiles overcoming the attraction of gravitation, the Jules Verne "of the future will take advantage of the electric currents connect-"ing different bodies of the solar system to call up the moon by "telephone and to connect Mars or the sun by telegraph. The "electric theory annihilates space and makes mock at time."

THE MIDWINTER FAIR.

Elsewhere Messrs. Hasson and Hunt give a very full collection of engineering and other data relating to the electrical features of the Midwinter Fair, held at San Francisco the first months of this year, and which was at the time very fully described in our columns. The chief interest attached to the data given does not relate to any efficient character of apparatus installed, for this was of the most haphazard description, nor to any particular economy in operation, which was impossible under the existing conditions. It consists rather in furnishing an object lesson showing what may be accomplished under the most hopeless conditions by engineers through a resort to expedients, and the vigorous exercise of executive ability. Notwithstanding the fact that in a limited time the electrical apparatus had to be gathered piecemeal and forwarded across the continent, the boilers and engines, new and second-hand, sought for in every part of the Pacific slope from owners apparently none too willing, and the odd assortment fitted to each other and the end in view, the electrical department was the only one ready on opening day, and during the exhibition its operation was as successful, so far as the Fair was concerned, as if at all parts of the plant had been especially designed for the purpose. While, as before stated, a high economy of operation was out of the question under the existing conditions, yet the results attained are very fair. The system of management cannot be too highly commended that comprised such an exhaustive method of classifying and keeping account of the various expenditures, and in this respect it serves as a model worthy of study by those who recognize the importance of this point in connection with every electrical plant.

POLARIZED ELECTRICITY.

A Dr. A. H. Stevens, of Philadelphia, claims to have made an important discovery in the treating of diseases by means of "electrical polarization." In a work on the subject which he has written, he states that books have erroneously undertaken to explain the circulation of the blood by "cardiac or heart power", which he declares to be false—"neither true nor philosophical, "being impossible from a natural law or standpoint." He claims to have undisputably proven that the blood is "both cleansed "and circulated through the entire system outward and brought "back, by the positive and negative forces of polarized electricity "as carried by nature herself from her own laws of balance and "equilibrium." He says that it is the "universal distribution of "this omnipresent element (polarized electricity) in the human "organism, viz.: too much in one place and too little in another, "that is, or produces, what we call disease," and his system consists in the application of a positive or negative electrode to restore the normal condition. The terms *electricity*, *polarization*, *positive* and *negative* appear to have great efficacy with the public, their use seeming to have a mysterious effect on the reasoning faculties which cause to be accepted as plausible the most absurd theories. In the present instance the author (who has something to sell) does not seem to consider it necessary to give the slightest plausibility to his arguments, apparently assuming that an involved use of the words referred to will alone have the desired effect in gulling the class to which he appeals. In order to catch attention, however, patriotism is appealed to, and the public reminded that "this new cure was born, or discovered, and first made known here "in our own beloved America, and not on the other side of the "great Atlantic," and some very sarcastic remarks are indulged in respecting "a certain Doctor Kotch, of Berlin, Germany," a rival to Dr. Stevens in the cure of consumption.

Electric Street Cars in Chemnitz.

A report by J. C. Monaghan, United States Consul at Chemnitz, Germany, states that city has banished horses from her street cars, substituting the trolley system of electrical propulsion. Instead of poles, the wires are hung from house walls. The system is simple, cheap, convenient, easily adjustable, and free from much of the ugliness inseparable from a network of wires.

The method of stringing or laying the wires is by rosettes fastened into the woodwork or walls of the houses, from which project hooks to which the wires are attached. In case of wooden walls, huge screws are placed into the wall; in case of stone, a long jagged iron is driven in and cemented. These are then tested with at least seven times the weight that they are expected to bear. Owners of houses, without exception, preferred to allow the use of their houses free to having a post on the sidewalk. The company holds signed and sealed documents from house-owners giving a year's right to the use of the walls for hooks and a further agreement to give a year's notice for removal. The system has now been in operation for six or eight months and has proven satisfactory and successful. No one has given notice to remove the hooks.

The cars have no conductors. The motorman is the only person on board who represents the company. By doing away with conductors, the company saves annually 44,000 marks. The fare is only 10 pfennigs, or a trifle less than 2½ cents on all routes, including transfers. Should 150,000 persons evade payment in twelve months, the loss would be 15,000 marks, or a very small trifle, not more than one-third of the 44,000 marks saved; 450,000 persons must evade fares in twelve months before the company's 44,000 marks of savings in salaries are made up. Among the people who pay for food and drink in saloons, beer gardens, etc., on their honor, not 150,000, 100,000, nor even 50,000 in a year evade fares. The consul is perfectly satisfied that the present system works successfully. In cases of evasion of fare, persons are punished both in the courts and by publicity in the newspapers—this latter to warn others. Fare boxes are attached to the front and rear parts of the car, hence no one has any excuse to offer as to difficulty of getting forward. Then, too, the "public eye" is always watching, and nobody wants to be even thought guilty.

Public opinion was divided between the trolley (overhead) and the underground system now operating in Budapest. It was claimed, and pretty satisfactorily proven, that in northern cities, where snow falls heavily and lies on the ground a long time, not only is the trolley best but the underground system is not satisfactory. The consul did not learn if any opinion was expressed as to the merits of the storage system.

Meeting of American Institute of Electrical Engineers.

At the October meeting of the American Institute of Electrical Engineers. two very highly mathematical papers were presented, one by Lieut. Samuel Reber, U. S. A., read by title, on "The Theory of Two and Three Phase Motors" and the other by Mr. Charles P. Steinmetz on "The Theory of the Synchronous Motor," which was read by the author.

The paper by Lieut. Reber gives an approximate mathematical solution of two and three phase motors on the assumptions that the change of magnetic properties of the iron and magnetic leakage are neglected, that the self-inductances are constant, and that the mutual-inductance between armature and field circuits follows a sine law, and that the field is supposed to be without projecting pole pieces. On these assumptions very elaborate equations are built up. Among the conclusions are that at a certain speed the torque of the type of motors considered is a maximum, and that a motor pushed in its work beyond this speed will stop, to prevent which the motor should not be loaded to a point more than half the maximum torque. The equations show that two and three phase motors have the same properties and differ only in constants, and that the most important relation is that of the armature resistance to the armature self-inductance speed. Constant current multiphase motors with no condenser will start well, have a low efficiency and will regulate poorly, owing to the torque decreasing if the speed is too slow. When the point of maximum torque comes near the point of maximum speed there will be good regulation, but the starting qualities will be poor unless resistance is introduced at the start and then cut out. A starting resistance is necessary in high efficiency motors. With a condenser in the armature circuit the starting torque can be increased without changing the resistance and thus increase of torque obtained, not by increasing the current in the field circuits but only in the armature. By the use of a variable condenser the speed can be made to increase up to synchronism and there is no overheating at low speeds nor waste of power by the insertion of resistance to increase the torque.

The torque and work of motors running under constant E. M. F., neglecting the change of the magnetic properties of iron at high magnetization, vary as the square of the field current. When the motor is at rest or just starting, the current is very large, and if there are other motors or lamps in the exterior circuit they are rendered unsteady at the moment of starting of the first motor, which may, however, be corrected by a secondary transformer. High frequency motors require a starting resistance, and in such motors the torque can be readily regulated by adjustment of the armature resistance, thus enabling the point of maximum torque to be thrown at any speed desired, and the smaller the magnetic leakage the more efficient will be the motor.

Lieut. Reber states that it is an advantage to increase the frequency until the hysteresis heating becomes too great or the motor runs too fast. Increase of speed gives an advantage in output until the machines begin to overheat. With a condenser the same facts hold but with the advantage that an increase in the frequency greatly reduces the size of condenser necessary. A high frequency motor will weigh less than a low frequency one, but when the clearance is large this advantage is not so decided, and when very large, low frequency motors are better if weight is no objection. The high frequency motor will contain less iron and more copper, and if the size of the motor is varied, keeping the magnetization constant, the output and hysteresis vary directly as the weight and as the heating of the field and armature circuits.

In the discussion, Prof. Pupin spoke highly of Lieut. Reber's paper and method. Mr. Steinmetz, while paying a compliment to the ability displayed by the author, objected decidedly to the mathematical method of the paper for the treatment of engineering problems. He showed a method of his own which he stated was much simpler while at the same time more comprehensive. Mr. Kennelly supported Mr. Steinmetz in respect to the superiority of his method.

In the introduction to Mr. Steinmetz's paper on "The Theory of the Synchronous Motor," the author states that the theory contained was written something over a year ago but was not intended for publication; owing, however, to the fact that Prof. S. P. Thompson's paper on "Some Advantages of Alternating Currents" read before the British Association, has brought the synchronous motor into discussion again, the paper is now published.

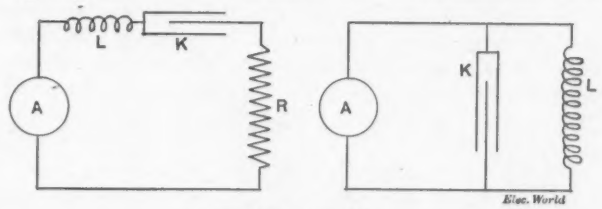
The treatment employed in this paper is also highly mathematical. It is shown that the two sides of the V-shaped curves of synchronous motors running light, published by Mordey and others, are not, as usually assumed, straight lines, but arcs of ellipses, the one of a concave and the other of a convex curvature. A deduction from these curves is that at no load the current of these motors can be many times larger than the current which would pass through the motor while at rest, having, in fact, the same value as would exist if flowing through a non-inductive circuit of the same resistance. The displacement of phase, lead or lag is a maximum when the power of the motor equals the power consumed by the resistance, that is, at an electrical efficiency of 50 per cent. Other deductions are made, but are only intelligible in connection with the equations to which they refer.

The Chicago meeting of the Institute was largely attended, the audience numbering not far short of a hundred. Prof. Stine, of the Armour Institute, had thoughtfully prepared lantern slides to illustrate the winding of induction motors, which added greatly to the interest of the meeting. Among those who took part in the discussion of the papers of Messrs. Steinmetz and Reber were Messrs. Stine, Sage and Edison. Prof. Owen's paper on the "Test of a Closed Coil Arc Dynamo," and Mr. E. G. Willyoung's paper on "Standardizing Electrical Measuring Instruments" were also discussed, the former by Mr. H. H. Wait and the latter by Prof. Stine, R. A. Stone and E. W. Ray. Mr. F. A. Hamilton, a member of the English Institute of Electrical Engineers, upon invitation of honorary secretary, B. J. Arnold, gave an interesting talk about various technical points in connection with ocean cables, on which subject he is a recognized authority, having been connected with ocean cable work for eighteen years.

Alternate Current Working—VIII.

BY HARRIS J. RYAN.

In practice all the conditions implied in the preceding formulas as necessary to obtain an exact balance between inductance and capacity could not in general be exactly realized. The results obtained for an actual case of this sort through an investigation conducted by Dr. Bedell and the writer are given graphically in Fig. 26. In this instance the alternator *A*, see Fig. 25, furnished current at a pressure of 1,080 volts and 143 p. p. s. A Swinburne 30-light "hedgehog" transformer was used at *L*; its induction current at no load, that is, with the secondary on open circuit, was .95 amperes. At *K* was placed a Stanley condenser that has a capacity of 1.02 microfarads. The instantaneous values of



FIGS. 24 AND 25.

the primary and secondary E. M. Fs. and the line currents between *A* and *K* and the transformer induction current between *K* and *L* were observed. In the diagram, Fig. 26, the corresponding curves are drawn. The induction current is labelled the primary current. The induction current is .95 amperes and the line current .187 amperes. The line current is made up of the differences between the induction and condenser currents. In this case the line current could never be practically reduced to zero. To reduce the line currents practically to zero the impressed E. M. F. and the induction current would have to conform to true sine curves, then the condenser current would vary as a curve of sines, and an exact balance could be brought about by adjustment. Here the alternator pressure does not quite form a sine curve, and the transformer induction current departs still more from the sine form on account of the irregular forces that are necessary for induction through the iron core. The condenser current presents a form such that its value at all instants is proportional to the rate of change of the E. M. F. impressed on its terminals. When the capacity of the condenser was adjusted so that the line current was a minimum, the residue current, which is the difference between induction and condenser currents, was determined and plotted in the diagram Fig. 26 as the line current. The curve labelled "condenser current" is determined by adding the ordinates of the line and the induction currents. The condenser reactance E. M. F. curve was determined graphically with the use of the planimeter by the method described in the Electrical World, Vol. XXIII, No. 1, p. 9, while the broken curve is the same curve actually observed as impressed E. M. F. The difference between the two curves is due to the condenser hysteresis, which in effect acts very much like the internal resistance of a storage battery. The reader should note the form of these

curves; they give one a good idea of the effects produced when the impressed E. M. F. departs from the sine form.

For the benefit of the reader who desires to go over the observed curves in Fig. 26 for the purpose of determining those deduced, the scales and areas of the original diagram are here given:

Length of one complete period..... 5.75 in.
" " 1,000 volts..... 1.63 in.
" " 1 ampere ..... .8 in.
Time of one complete period.....1-142 sec.

Value of one square inch of area enclosed by condenser current, ,490 volts, determined as follows: Remember that one ampere

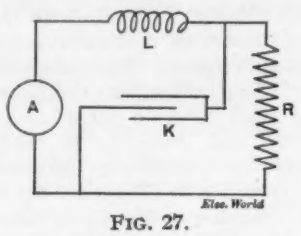


FIG. 27.

established through one farad for one second would produce a uniform rise of pressure in the condenser from zero to one volt, and through a microfarad this rise would be 10^6 volts. On the diagram consider one ampere to have been established through the condenser during the time of one completed period 1-142 or .007 seconds. At the end of this time the condenser pressure would be

$$\frac{10^6 \times 1 \times .007}{1.02} = 6{,}860 \text{ volts.}$$

The area developed in the diagram by one ampere through .007 sec.

$$.8 \times 5.75 = 4.6 \text{ sq. in., whence}$$
$$1 \text{ sq. in.} = 6{,}840 \div 4.6 = 1{,}490. \text{ volts.}$$

In the diagram the area enclosed by the condenser current is divided into sections and the areas from the zeros to the ends of each section as originally observed on the planimeter are recorded in the diagram. The products of these areas into 1,490, the volts per square inch give the E. M. F.'s that located the curve "E— obtained graphically from C."

will be made. In doing this the first thing is to fix the relative positions and amounts of the several currents and E. M. F.'s. Assume K to be subjected to a pressure of 10,000 volts, and from the relation

$$E = \frac{C}{K\omega}$$

we find the current through K to be

$$C = E\,K\,\omega = 10{,}000 \times 6.35 \times 10^{-6} \times 785$$
$$C = 5. \text{ amperes.}$$

At 10,000 volts the current through R will be 10 amperes. In Fig. 28 these currents are plotted with proper positions and values.

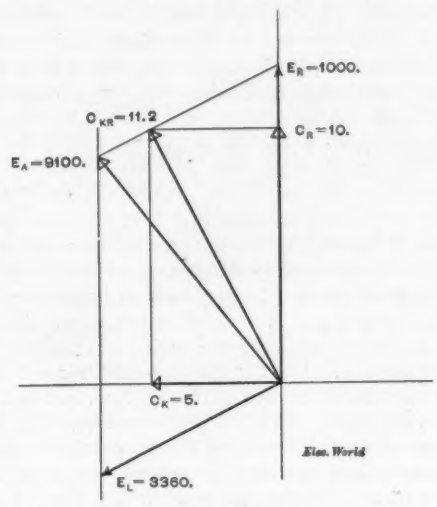


FIG. 28.

In the diagram C_{KR}=11.2 amperes is the current that passes through L, whose reactance produces an E. M. F.

$$E_L = C\,L\,\omega = 11.2 \times .383 \times 785$$
$$E_L = 3360. \text{ volts.}$$

Remembering that the E. M. F., which overcomes the pressure

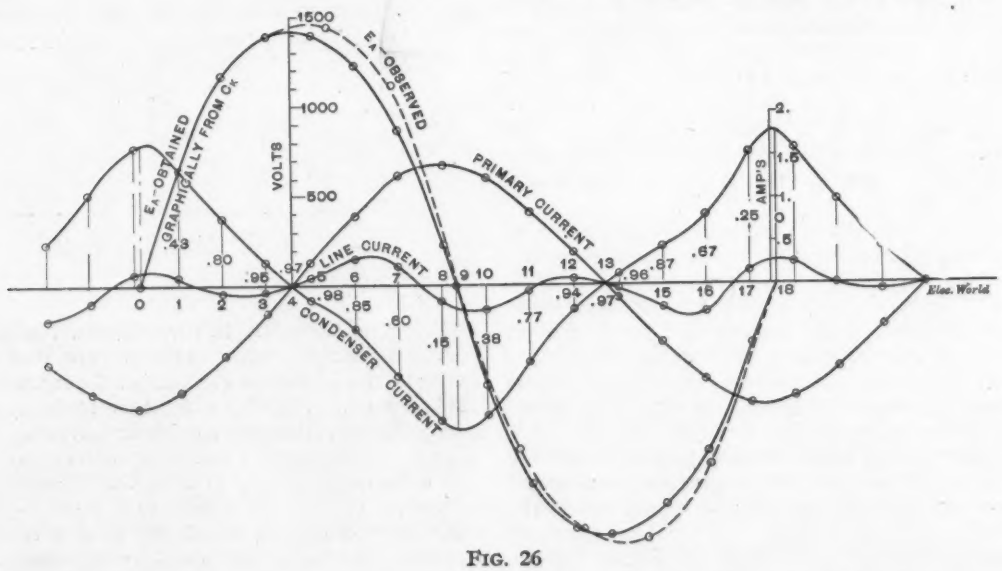


FIG. 26

caused by induction reactance, is 90 degrees in advance of the current, E_L = 3,360 is plotted, therefore, to the left at right, angles to C_{KR}. The diagonal of the parallelogram formed by E_R and E_L is the pressure E_A = 9,100 volts that the alternator must furnish in order to maintain a pressure on R of 10,000 volts. We have now determined the positions and relatives values of the E. M. F.'s and currents for this circuit. So long as K L and R remain constant the positions will remain the same, and the values will retain the same relative proportions. Therefore if A furnishes 10,000 volts, the pressure maintained on R will be

$$\frac{10{,}000 \times 10{,}000}{9{,}100} = 11{,}000 \text{ volts.}$$

The remaining values would be increased in the same proportion, for example the alternator current C_{KR} would be

$$11.2 \times 1.1 = 12.3, \text{ amperes.}$$

The capacity by computation that should produce a current that would balance the induction current is

$$\frac{C}{K \times 10^{-6}\,\omega} = \frac{.95}{K \times 10^{-6} \times 2\pi \times 142} = 1{,}080$$

$$K = .985 \text{ microfarads,}$$

while 1.02 microfarads were used in the experiment.

The diagram of Fig. 27 illustrates a circuit that is now met with occasionally in practice. A is an alternator that furnishes power to lamps or motors at R, the line thorugh its own properties or those of auxiliary apparatus possesses inductance and capacity, represented by L and K. The induction reactance is in series with the load resistance and the capacity reactance, the last two being in parallel. The effect of the reactance of L and K is to elevate the pressure on R over and above what it would be without the presence of the capacity K. What pressure will R be subjected to when A produces 10,000 volts at 125 p. p. s.? L = .383 henrys; K = 6.35 microfarads; and R = 100 ohms. A graphic solution of the problem

(To be continued)

ELECTRIC SYSTEM OF THE PHILADELPHIA TRACTION COMPANY

BY HERMANN S. HERING.

III.

POWER DISTRIBUTION (Continued).

The general system of feeding a line, together with the arrangement of subways, manholes, etc., is shown in Fig. 19, which, however, contains only the circuits for two of the lines, but it is a typical diagram and shows the method adopted for all of the lines operated by this company. The enlargement of the vicinity of 13th and Mt. Vernon streets, in the lower portion of the diagram, shows

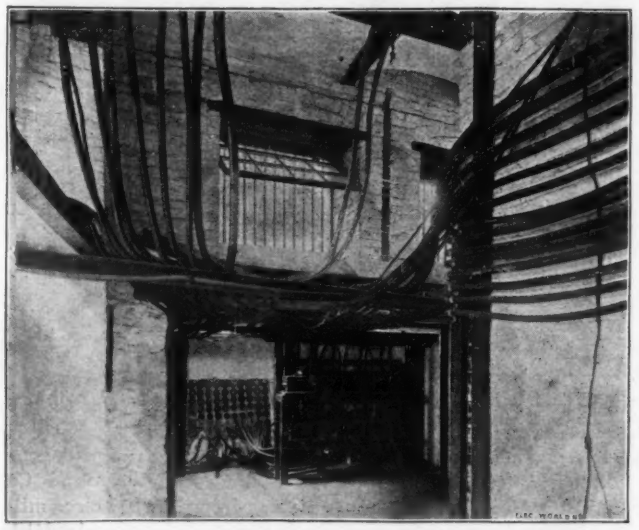


FIG. 22.—ONE OF THE VAULTS, STATION B.

the feed cables clearly, and gives their cross section in circular miles, together with their designating number.

By following any one of these cables from the station, the section it feeds can readily be found, the number and location of the taps, the feeder poles, manholes, etc. The section insulators show the limits of the portion of the line fed by any one cable. The dotted lines drawn in the middle of the street show the location of the subways. The cables are of necessity drawn diagrammatically and obviously belong in the subways of the streets which they feed and near which they are drawn. For instance, cable No. 22, 400,000 circular mils, starts from manhole 173 at 13th and Mt. Vernon, runs down 13th street to Wood street, west on Wood street to 15th, south to Chestnut street, west to 16th and down to Pine street, where it terminates, having a total length of about 8,120 feet. It feeds the 16th street line from near Market street to near South street, a distance of 3,000 feet, and is tapped at manholes 36, 39 and 41, which are about 1,000 feet apart. As another illustration, follow cable No. 2, 500,000 circular mils cross-section; starting from manhole 363, near the station, it runs out Ridge avenue to 15th street and then north to Berks street, a distance of about 6,960 feet. It feeds the line from near Norris to near Master street, a distance of about 3,200 feet, and is tapped at manholes 120, 123 and 127, which are a little over 1,000 feet apart. The taps are numbered with the number of the cable. Roughly the taps are made about 500 to 1,000 feet apart, and the manholes located from 200 to 500 feet apart, 400 feet being the standard. On these two lines there are 100 taps and 373 manholes. Diagrams of this character and scope are prepared for every line operated by this company and are used by the supervising engineers in directing the linemen in locating trouble, making repairs and testing cables and for general reference in the office.

The longest cable for these lines is No. 8, 700,000 circular mils cross-section, which feeds the south end of 15th street, its length being about 16,160 feet.

These two lines have a length of about 22 miles of single track and run about 130 cars, at an average of about 2½ minute intervals. They are fed by means of 31 cables, aggregating a length of 250,560 feet, or about 47½ miles, and having a total cross section near the station of 14,481,200 circular mils, which is equal to 11.37 square inches.

The total mileage of feeder cable operated at present over the entire system, is 225 miles, but more is being laid continually for the extensions. These two lines represent about one-third of the car equipment and one-fifth of the mileage of the system as it is operated at present.

The cross section of the cables was calculated for a maximum rise in temperature of 14 degrees, with a liberal allowance for increased traffic and for extra loads caused by blockades, etc., as the cables were to be laid permanently. The sum of the cross sections for any line do not represent the proportional output of the station for that line, but each cable was calculated for the maximum possible load to which it might individually be subjected without overheating or causing much drop in pressure. For instance, any feeder could supply, without danger, all the cars that could possibly run on its section and at the same time take care of an adjacent section whose cable may have become disabled. In a permanent underground system, in a large city, such precautions are imperative, and although this company has been severely criticised for laying so much copper, they have shown their excellent judgment in equipping their system in the most substantial manner, and will greatly benefit thereby.

The return feeders consist of twisted tinned copper wire, of 1,000,000 circular mils cross section at the station, and one of these run along each subway, and is connected with the rails at every manhole. This feeder is not grounded along the road, but runs direct to the negative bus bar on the station switchboard, thus practically preventing electrolytic action. The lead armor of the feeder cables is connected with the return feeder at every manhole to neutralize any potential difference that might arise there and cause electrolytic action, and so the lead sheathing acts as a return also. The return feeders are calculated for maximum demand on any line, and therefore for the maximum station output for that line. There are about 52 miles of return cable in operation.

UNDERGROUND CONSTRUCTION.

As already mentioned, the underground system of this company is the most extensive of any line at the pesent day, and its operation is being watched by many railway companies, as the question of

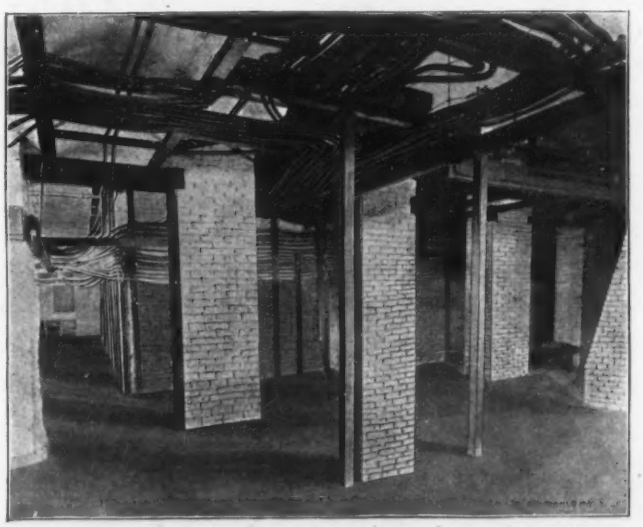


FIG. 23.—FEED CABLES, BASEMENT OF STATION B.

underground feeders is being agitated in most of the larger cities. This system has worked with perfect satisfaction so far, and having been installed in a most careful and substantial manner it gives promise of great durability. All parts of such a system need to be frequently inspected to prevent breakdowns from any avoidable causes.

The subways are composed of conduits made of a tough wrought

iron shell, lined with about 3-16 inch of cement concrete whose interior surface is smoothly finished, leaving a hole about 3 inches in diameter through which the cables are drawn.

These conduits are laid together with about three inches of concrete between them, and all placed about two feet below the level of the street. Manholes are located about 200 to 500 feet apart and are built up of brick walls and have cast iron covers and water tight plates. The cables are connected in water tight junction boxes, from

Fig. 23 is a view of a portion of the basement at 13th and Mt. Vernon streets, looking from one of the vaults, and shows the feed cables on the ceiling. A diagram of the junction box used in the vaults, is shown in Fig. 24. This was designed by the company's engineers and is very simple in construction and has proved very satisfactory so far. It consists of a cast iron base, with terminals into which the wires are brought and securely fastened and insulated. Connections are made with links and locked wing-nuts. A wood-

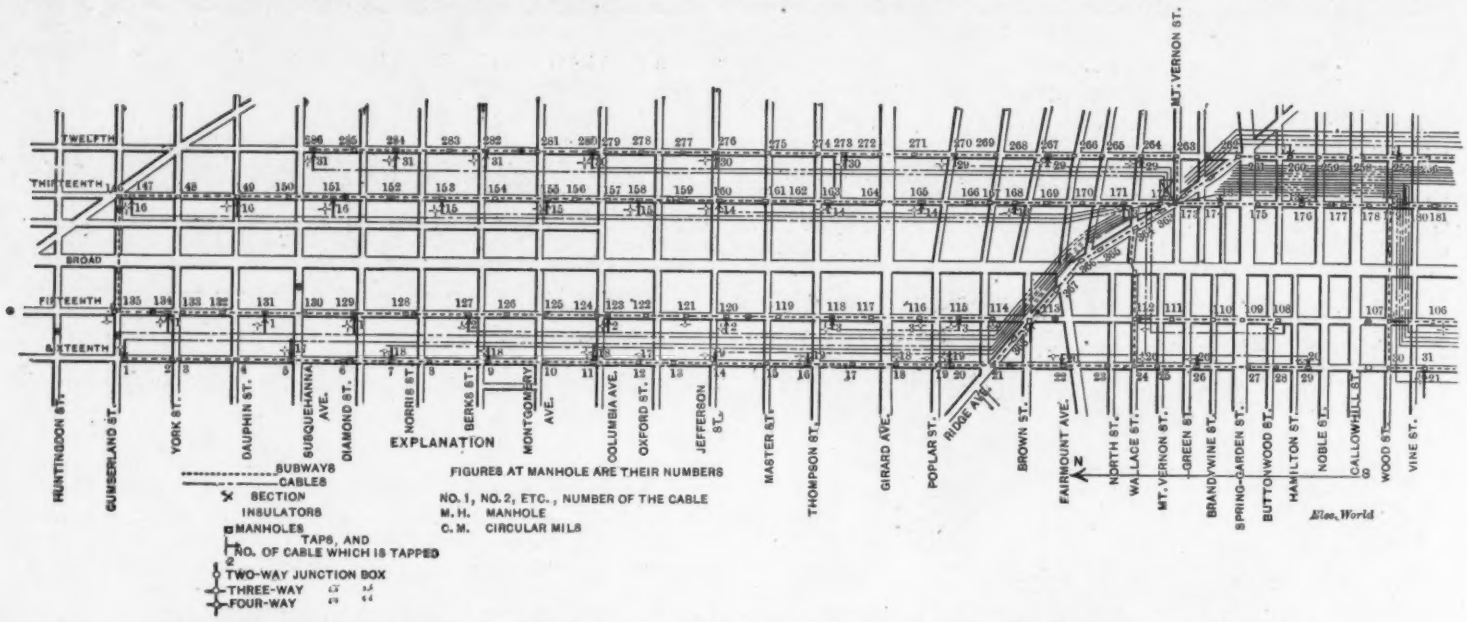
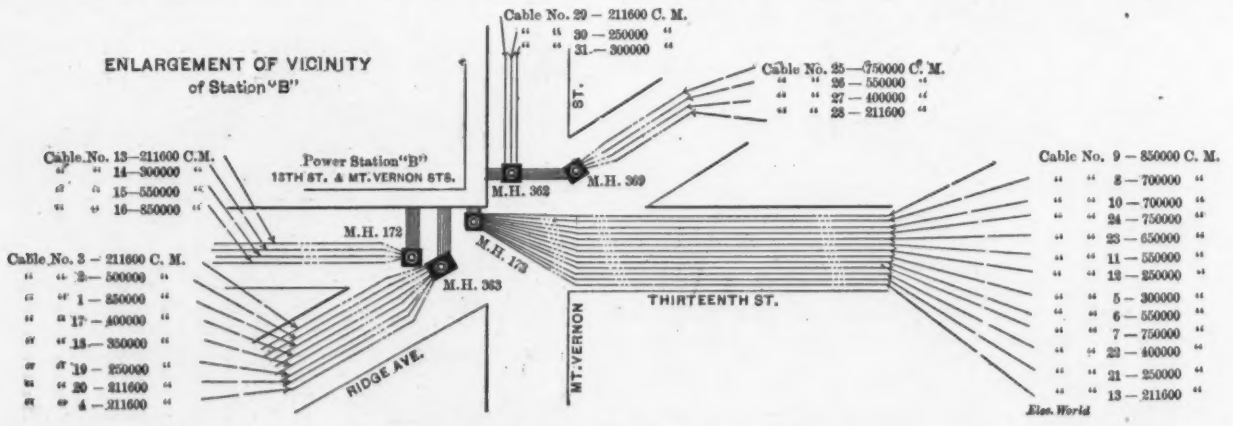


FIG. 19.—MAP OF SUBWAYS, FEED-CABLES AND MAN-HOLES, 12TH AND 16TH STS. AND 13TH AND 15TH STS.

which all taps are made; and at which any section of cable can be disconnected in case of trouble. The manholes are connected with the sewer by means of bell-traps, but water rarely gets into them. At present* there are 1,209 manholes and 425 feeder junction boxes in the entire system, and the length of single duct laid approximates 800 miles.

Fig. 20 is a sketch of the underground and overhead construction, and shows the section of a manhole with subway, junction box, tap and return feeder. This subway has only four ducts, but some contain as many as 70, the number depending upon the largest number of cables likely to be laid in that vicinity. The overhead construction will be referred to later on.

In all of the power stations the feeders are brought from the switchboard through the basement to the vaults, which are located



ENLARGEMENT OF DETAIL IN FIG. 19.

under the sidewalks. In these vaults are the junction boxes which connect the station cables with the street cables.

Fig. 21 is a plan and section of the four vaults at 13th and Mt. Vernon streets and shows the method of construction. Fig. 22 is a view of one of these vaults and shows the terminus of one of the subways and a bank of junction boxes, together with the cables leading to them. The cables of twisted wires seen in the middle of the picture, are some of the return feeders, and are more than an inch in diameter. The windows are the basement windows looking into 13th street.

*Oct. 1, 1894.

lined cast-iron cover is bolted to this base and made water tight by a rubber gasket.

The feeder cables for the entire system which are lead-armored and braided, were furnished by the Standard Underground Cable Company, of Pittsburg, and range in size from 211,600 circ. mils to 950,000 circ. mils, the style used being the regular "Standard" lead covered "Waring" cable. In addition to the lead cover the cables are protected on the outside of the lead by a heavy protective braid saturated with a preservative compound, or with a tin coating. Some idea of the extent of the work in Philadelphia may be conveyed by the fact that the Standard Company has been laying cable there at the rate of 10,000 to 12,000 feet per day for more than a year, and that it has already laid over 600 miles of heavy feeder cables. The return cables were furnished by Jno. A. Roebling's Son's Company, of Trenton, N. J., and the conduits by the National Conduit Company, of New York and the Wycoff Creosote Tube Works of Williamsport, Pa. The manhole tops, of which there are over 1,200, were made by the Pennsylvania Iron Works Company.

OVERHEAD CONSTRUCTION.

The general sketch of the side pole construction is shown in Fig. 20, and this constitutes the style of most of the equipment, there being but little centre pole construction, not more than five miles. The poles are of the best quality of wrought iron pipe and were furnished by Morris, Tasker & Company, of Philadelphia. They are about 28 feet long, of extra heavy pipe, built in 4, 5 and

6-inch sections, though some of them are much heavier. They are set in 5½ feet of concrete formed of Portland cement, slag and sand. The poles are set about 125 feet apart, and at present there are about 15,000 in use. At the feeder pole head, where the feed wire is brought out to be connected with the trolley, there is special precaution taken to avoid grounds. The insulated wire is brought up the interior of the pole, and at the top is connected by means of a junction with a wire running to the trolley span wire by which the trolley wire is fed. This junction is made by means of two brass lugs, which are soldered, one to the wire from the conduit and the other to the wire going to the trolley. The joint of the cable wire is embedded in compound and protected by a hard rubber plate. These two lugs have a conical joint and can be wedged

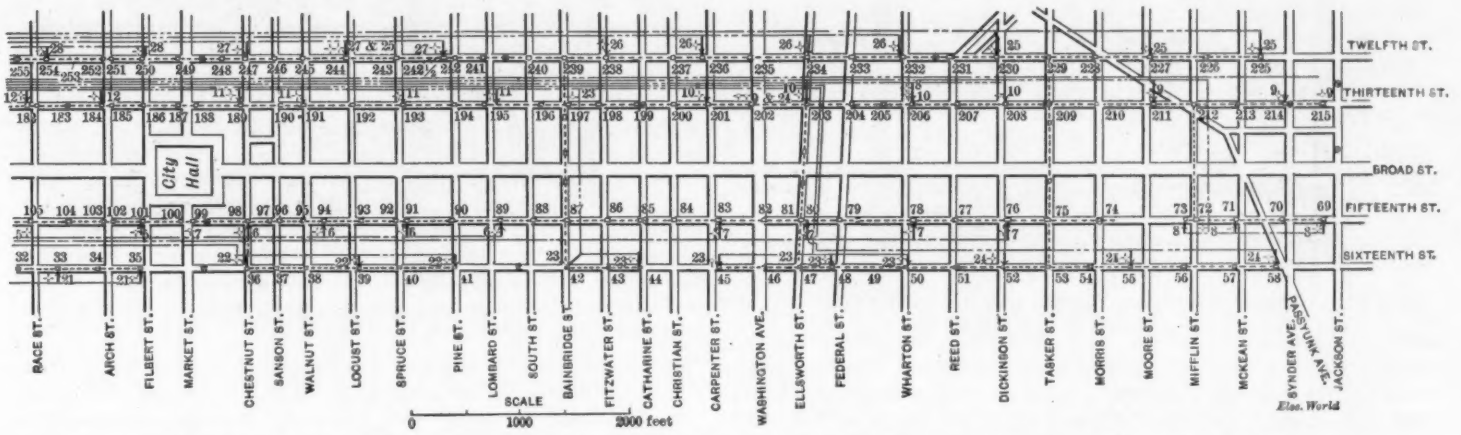


FIG. 19.—MAP OF SUBWAYS, FEED-CABLES AND MAN-HOLES 12TH AND 16TH STS. AND 13TH AND 15TH STS.—Continued.

together by means of the bolt shown. A hard rubber sleeve insulates the wire going to the trolley while leaving the pole. The whole is protected from rain by a cap and shield, and the trolley span wire is provided with extra heavy insulated turn buckles. Fig. 25 is a sketch of a typical feeder pole head.

The trolley wire is No. 0, B. & S., hard drawn copper, supported by hangers of moulded mica with soldered clips. The guard wires are No. 6 B. & S. silicon bronze and are placed 18 inches above the trolley wire and three feet apart, and are also supported on insulated hangers. The span wires are No. 3, B. & S. silicon bronze, and are secured to the poles by the Brooklyn insulated turn buckle.

Section insulators are placed at intervals of from 1,000 to 4,000 feet according to circumstances. The sections can be connected through junction boxes, and no switches are used. The trolley wire is anchored on each side of curves and about every 1,200 feet on straight stretches.

Lightning arresters, which are connected to the return feeders are placed on every feeder pole, and a choking coil is placed on the trolley feed wire between the feeder head and trolley wire.

TRACK CONSTRUCTION.

Not only have new rails been laid for the electric system, but the streets have been repaved from curb to curb on all of the lines, with either asphalt or belgian blocks, this being one of the conditions under which the franchise was granted by the city government. Fig. 20 shows a general view of the street work, which is of the most approved character. The rails are 90-pound side-bearing, steel, girder rails, 9½ inches high, well spiked to ties laid in gravel. A feature of the track construction is the special rail work, crossings, turn-outs, frogs, etc., which is all integral work of special design and of a most substantial character. The rails and special work were furnished by Wm. Wharton, Jr., & Co.

The rails were laid with special care and the alignment is probably as good as it is possible to obtain. The gauge is 5 foot 2¼ inches.

All of the joints are lace-bonded with No. 0 B. & S. tinned cop-

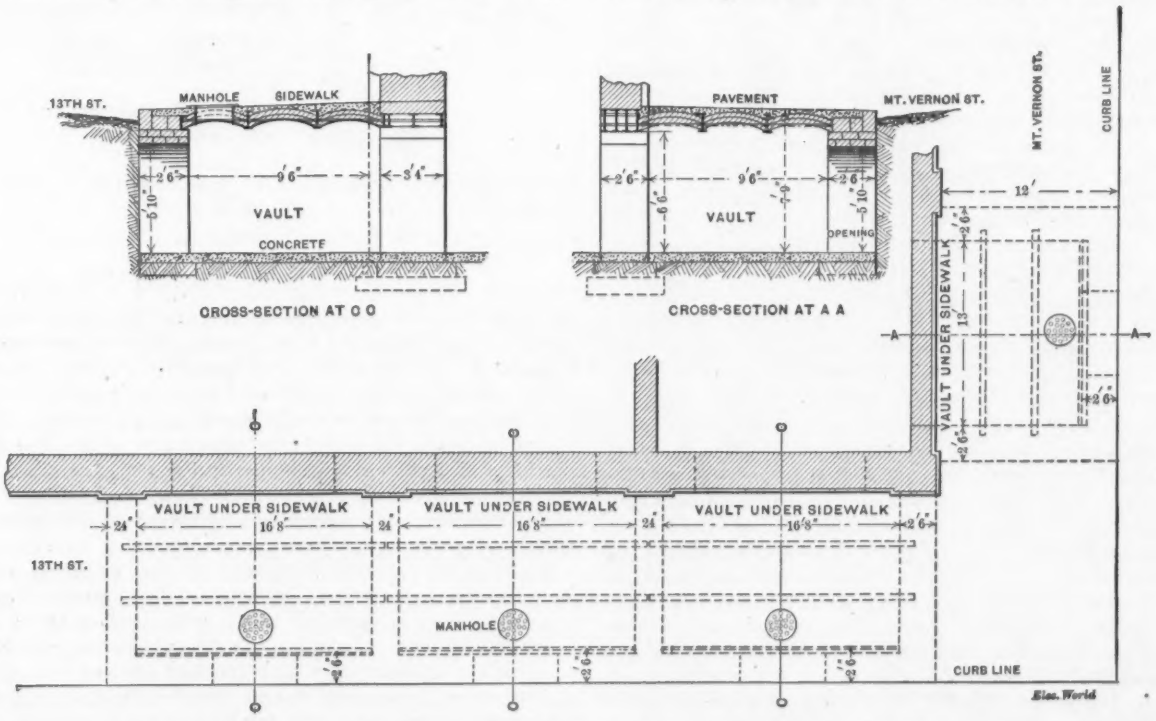


FIG. 21.—PLAN AND SECTION OF VAULTS UNDER SIDEWALKS, STATION B.

per wire fastened by channel pins, and the rails are cross-bonded every 60 to 90 feet. The joint next to the manhole is tied to the return feeder.

ROLLING STOCK AND CAR EQUIPMENT.

The cars for this system were built by J. G. Brill & Co., Philadelphia, Lamokin Car Works, Chester, Pa., and the LaClede Car Com-

pany, St. Louis, Mo., and are of the latest design and most substantial character. They are equipped mostly with Bemis trucks, but some have Brill maximum traction trucks. The Darby road cars (suburban) are 30 ft. long and have double trucks (Brill maximum traction trucks); the remainder are 16 and 18 ft. long, with single trucks. Fig. 26 is a dimension sketch of a typical closed car of

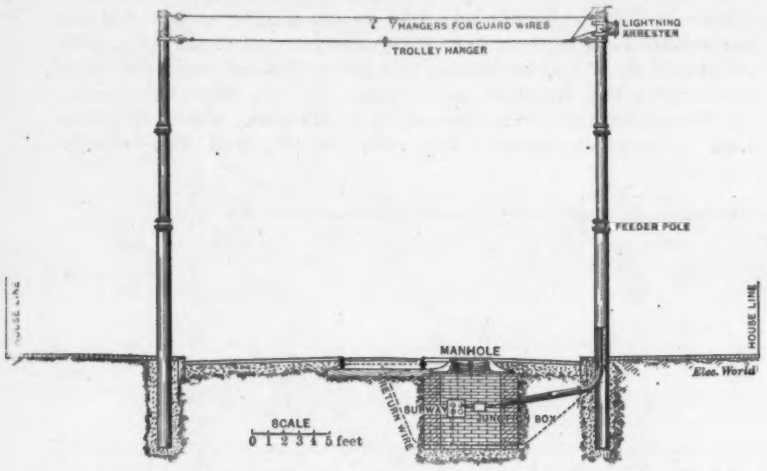


FIG. 20.—UNDERGROUND AND OVERHEAD CONSTRUCTION IN USE BY PHILADELPHIA TRACTION COMPANY.

this system. There are a few open cars with cross seats on one or two of the lines, but there are a large number of so-called "smoking cars," which are open cars with two seats in the middle, back to back, running lengthwise, and on any part of which passengers are permitted to smoke. There are altogether about 400 cars being operated on the system at present, but it is expected that this number will be doubled before long. The number of cars running on each line was given in Table II.*

There are at present ten car barns for the electric cars, as follows: 49th and Darby Road, 42nd and Chestnut streets, 44th and Girard avenue, Sutherland avenue and Christian street, Jackson and

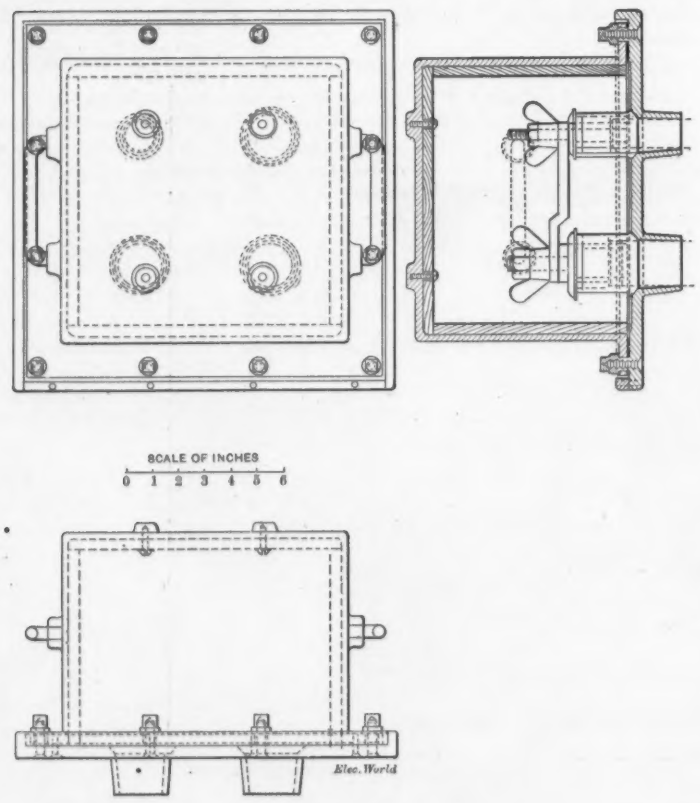


FIG. 24.—JUNCTION BOX USED IN THE VAULTS.

13th street, Wharton and 20th street, Cumberland and 15th street, Ridge avenue and 32nd street, Hancock and Lehigh streets, Gray's Ferry and 37th street.

The electrical equipment for the cars has all been furnished by the Westinghouse Company; most of the cars are equipped with two No. 3 25-hp motors, and the Darby Road cars (double truck, suburban) with two 30-hp motors, and D, E, and G controllers. In the heart of the city the cars are run on the 3rd notch of the controller

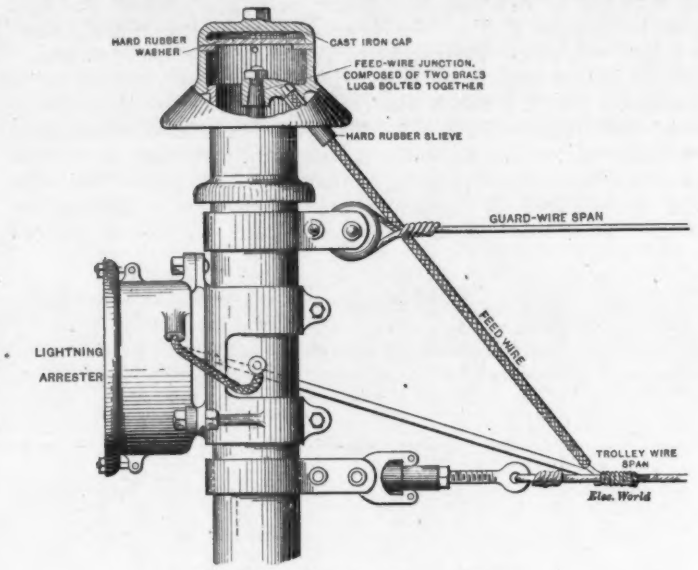


FIG. 25.—FEEDER-POLE HEAD.

(motors in series) owing to the crowded condition of the streets and the large number of stops required. Where the streets become freer, the 10th notch is usually used, but a high average speed can not be attained as the law requires the cars to be brought to a standstill at every street crossing. The average round trip speed is about 10 miles an hour, and the daily mileage is about 130. The cars are all

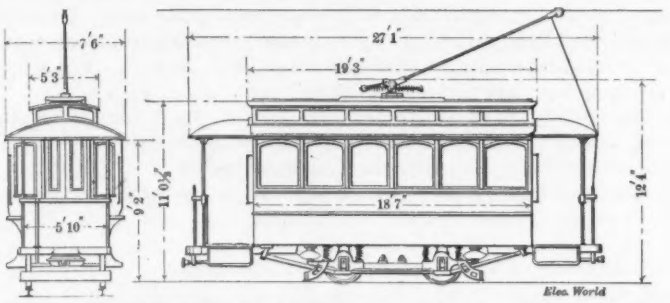


FIG. 26.—DIMENSIONS OF STANDARD CAR OF THE PHILA. TRACTION COMPANY.

equipped with the Nuttal Trolley pole, which is giving perfect satisfaction. (To be continued.)

A Submarine Detector.

About a year ago a Russian monitor foundered with all hands in the Gulf of Finland. The Russian Government was anxious to ascertain exactly where and how the disaster occurred. During the present summer a flotilla of boats has been patrolling the Gulf of Finland with a view of discovering the wreck. To increase the chance of the success of this search one of the boats was provided with a McEvoy electric submarine detector specially modified to meet the peculiar circumstances of the case, and a few weeks ago the unfortunate ship was localized by means of the detector in 30 fathoms of water, and divers were sent down to examine her. The McEvoy detector is designed on the principle of the Hughe's induction balance, and as used in this search it consisted of two primary coils conected in series with each other, a battery with a make and brake contact in the primary circuit, and two secondaries, wound in opposition, with a telephone placed in their circuit. The battery with the make and brake contact, one primary coil, one secondary coil, and the telephone were on deck, the rest of the apparatus being trailed along the bottom of the sea at depths ranging from 15 to 50 fathoms. When the search vessel passed over the wreck, the presence of the submerged ironclad was detected by the complete upsetting of the balance of the apparatus, which thus gave indubitable evidence of the presence of a large mass of magnetic metal. Capt. M'Evoy designed his detector primarily with a view of enabling those in charge of a system of submarine mines to detect the approach of a hostile ship; each mine having a secondary and primary coil, the rest of the apparatus on shore.

*See The Electrical World, Oct. 20, 1894, p. 384.

Light from Electric Oscillations.*

BY H. EBERT.

In recent times investigators have applied themselves with ever increasing interest to the problem of producing light by electric oscillations or alternate currents of high frequency, such as are obtained by condenser discharges. Only in a few isolated cases, however, have the arrangements fulfilled the necessary conditions for obtaining the maximum lighting effect from the given supply of energy. Furthermore, as far as known to the author, there have been no measurements made of the economy of lighting effected in this way. However brilliant the luminous effects obtained by Tesla may have been, it is only by measurements of the total energy expended to produce the lighting effect that we can hope to arrive at a conclusion as to whether an economical advance in the art of lighting is to be expected from this system. The author wishes to show that by observing the necessary conditions, considerable light effects can be obtained by very simple means from very long continued electrical movements of the kind just mentioned.

The conditions necessary for obtaining the maximum luminous effects by the influence of electric oscillations on rarefied gases, have been investigated by E. Wiedemann and the author by means of Lecher's parallel wire arrangement. In all cases the result was obtained, that the best effects could only be attained when the secondary circuit was exactly "tuned" to the primary discharging circuit. The oscillations in the secondary circuit must in fact be what is called in the theory of sound, resonant. It was found also that perfectly regular oscillations could be obtained only when air condensers were employed. When the Leyden jar, or any other condenser with solid dielectric was used, disturbances and irregularities were introduced by the well known residual actions that occur in these cases.

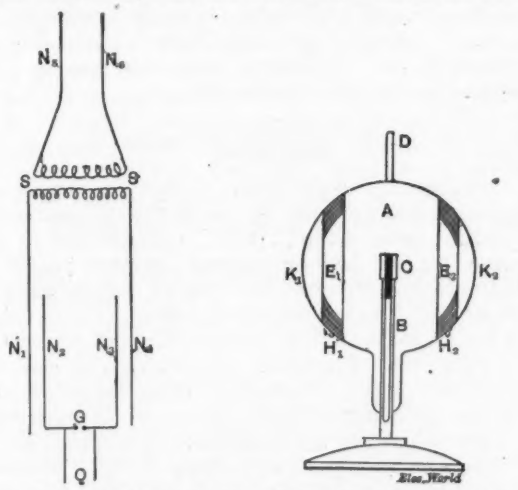


FIG. 1 AND 2.—DIAGRAM OF CONNECTIONS AND LUMINESCENT LAMP.

These, and similar experiments, show that to obtain luminous effects in a rational manner by means of electric oscillations or high frequency currents, we must—

Firstly.—Time the primary and secondary circuits exactly to one another. That is to say, the time of oscillation $T = 2\pi\sqrt{LC}$. must be the same, or in a simple harmonic relation for both circuits.

Secondly.—The capacity of the air or oil condensers in the circuits must be as small as possible in order to reduce the damping to a minimum. The logarithmic decrement of the electric oscillations is given by the expression $\pi R\sqrt{C/L}$ (R, the ohmic resistance; C, the capacity; and L, the self induction of the circuit). It appears from this expression that, as stated, C must be as small as possible, and L as large as possible for a given R; but the limit of increase of L is soon reached.

It is not necessary to use high tensions, since it has been found that intense light effects can be produced by the movement of exceedingly small quantities of electricity, provided only that the oscillations follow each other regularly and are persistent.

Keeping these considerations in view, a simple apparatus has been designed which has proved very effective for producing electric light by high frequency currents. The principle of the apparatus can be readily seen from the diagram of connections (Fig. 1). The current (from an influence machine, an induction coil, or a sufficiently highly transformed alternating current) coming in by the conductors, Q, charges the two condenser plates N_3 and N_5, which, thereupon, induce upon the plates N_2 and N_4, corresponding charges. When a spark passes at G, the charges heaped upon N_1 and N_4 equalize themselves, with oscillations, through the coil, S. Round this coil, S, is wound a similar coil connected to the plates, N_5 N_6, of the secondary condenser. Between these two plates is developed the high frequency field. Vacuum tubes or other objects to be acted upon may be introduced between the plates, N_5 and N_6 or they may be metallically connected to them by wires. There is thus no direct metallic connection between the primary and secondary circuits, but they mutually act upon one another by the lateral induction of the spirals. By changing the distance between the condenser plates, the two circuits can be tuned into exact unison with one another. By changing the capacity, by applying longer or shorter spirals, S, or by increasing or diminishing the length of the primary spark gap, or the number of the sparks, the conditions of the experiment can be indefinitely varied, and, more especially, the frequency of the oscillations can be varied within wide limits.

The condensers are simply made of couples of metal plates mounted so as to slide on glass rods passing through their centres. There is no danger of leakage along the glass rod, as the spark gap is only 2 to 3 mm in length. It is found to be much better to use many small sparks, provided they are regular and sharp, than long sparks.

With this apparatus, 20,000 oscillations will take place before the amplitude is damped down to the 2.7th part of the original value. If the number of sparks at G is sufficiently increased (and this can be done without a large supply of electricity on account of their shortness), the field between N_5 and N_6 may be kept in an almost uninterrupted state of oscillation.

Since everything in the wave apparatus is so adjusted that the activity of the oscillation is a maximum, only a very small exciter is necessary. Even a single plate influence machine serves to excite it, though, of course, the phenomena with a multiple plate machine are much more brilliant. A medium sized induction coil gives very fair luminous effects, but generally it is not so suitable as the influence machine, because the supply of electricity is not usually sufficiently regular.

The application of this resonant wave apparatus to the excitation of vacuum tubes, and to spectroscopic investigations at low temperatures, is described, but we give here only its application to the production of light. Wiedemann and the author had shown in previous investigations that regular, weakly damped, electrical oscillations possessed a very remarkable power of exciting cathode rays of great intensity, which have a remarkably great capacity of producing fluorescence or phosphorescence, or to speak generally, luminescence, with very small expenditure of energy.

Even with very small sparks and amounts of energy on the secondary condenser, these cathode effects attain, when everything is properly tuned, an intensity which is quite comparable with that obtained by using large alternating generators. If a suitable phosphorescent substance is exposed to these rays, it will emit a considerable amount of light. Even when powerful alternating currents are employed to excite the phosphorescence, scarcely any heat is produced. A lamp is thus obtained which emits almost only visible rays, without development of heat, and consequently the amount of energy which the lamp consumes is enormously small.

A simple, but very economical "luminescent lamp" may be constructed by fusing the glass tube, B, Fig. 2, in the glass bulb, A, closing it at the lower end, and fixing a disc, C, of compressed luminous paint (Leuchtfarbe) by a wire at the top. The bulb is then exhausted by the tube D, and closed. Two strips of tinfoil, E_1 and E_2, are glued on, and furnished with hooks, H_1, H_2 to which the condenser plates, N_5, N_6, of the wave apparatus are connected. When the electric oscillations act upon the coatings, E_1, E_2, active cathode rays are formed on the inner surface and perpendicular to it. These rays, though almost invisible themselves, produce a strong luminescent light upon the surface of the luminous paint on which they converge, and the light radiates out through the transparent ends, K_1, K_2, of the bulb.

A series of preliminary experiments were made to determine the efficiency of the "luminescent lamp." The candle power was found to be about one-thirtieth to one fortieth of the amyl acetate standard, which is approximately equal to the standard candle in this country. The energy expended being difficult to measure directly, was calculated from the capacity and potential of the secondary circuit. It was found that the energy actually expended in producing the light was aboutone-millionth part of a watt. By

*From the London *Electrical Review*. Summarized from *Wied. Ann.*, Vol. liii., p. 144.

comparing the brightness of this lamp in the visible part with that of the amyl acetate lamp, and calculating for both the *total* energy consumed in their maintenance, it was found that the high frequency lamp consumed from 1,500 to 2,000 times less energy than the amyl acetate standard. One difficulty in the way of the practical application of the high frequency lamp is that the high frequency currents could not be carried to great distance even in a straight cable, on account of the reactance which self-induction would oppose to such rapid oscillations; but the difficulty may to a certain extent be overcome by effecting the transformation to high frequency at the lamps. Since only condensers of small capacity, and small inductances are required, a simple and very compendious apparatus of the kind described could be combined with the lamp.

The economy of all arrangements which were not perfectly tuned as above explained, was found to be much less.

Electrodynamic Machinery—XIV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

69. When a conducting wire is moved through a magnetic flux, there will always be an E. M. F. induced in the wire, unless the motion of the wire coincides with the direction of the flux, or, in other words, unless the wire in its motion does not pass through or cut the flux. Thus, if, as in Fig. 50, a straight wire A B, of l cms length, extending across a uniform flux, be moved at right angles to the flux, either upwards or downwards, for example, to the position a b, or a′ b′, it will have an E. M. F. induced in it, the direction of which will change with the direction of the motion.

70. A convenient rule for memorizing the direction of the E. M. F. induced in a wire cutting, or moving across magnetic flux, is known as Fleming's hand rule, illustrated by the *right* hand in Fig. 51. Here the thu*m*b indicates the direction of motion, the *f*orefinger

Fig. 51.

the direction of the magnetic flux, and the *m*iddle finger the direction of induced E. *M.* F. For example, if, as in Fig. 50, a wire be moved vertically downwards from A B to a′ b′, and the thumb be held in that direction, the forefinger pointing in the direction of the flux, the E. M. F. induced in the wire will take the direction a′ b′, during the motion, following the direction of the middle finger. If, however, the wire be moved upwards through the flux, application of the same rule will show that the direction of the induced E. M. F., *i.e.*, of the middle finger, is now changed.

71. The induction of electromotive force in a conductor, moving so as to pass through or cut magnetic flux, is called *electrodynamic induction*. The value of the E. M. F. induced in a wire by electrodynamic induction depends on the density of the magnetic flux, the velocity of the motion, and the length of the wire. This is equivalent to the statement that the E. M. F., induced in a given length of wire, depends upon the total amount of flux cut through by the wire in the same direction per second; or,

$$e = \mathfrak{B}\, l\, v \text{ C. G. S. units of E. M. F.}$$

Where $\mathfrak{B}$, is the intensity of the flux in gausses, l, the length of the conductor in cms, v, the velocity of motion in cms per second, and e, the induced electromotive force as measured in C. G. S. units. One international volt is equal to 100,000,000 C. G. S. units of E. M. F., so that the E. M. F. induced in the wire will be

$$e = \frac{\mathfrak{B}\, l\, v}{100{,}000{,}000} \text{ volts.}$$

72. The preceding equation implies the supposition that the wire is not only lying at right angles to the flux, but also that it is moved in a direction at right angles to the direction of the flux. If the wire, instead of being at right angles to the flux, makes an angle β, with the perpendicular to the same, as shown in Fig. 52, then the length of the wire has to be considered as the vertical length across

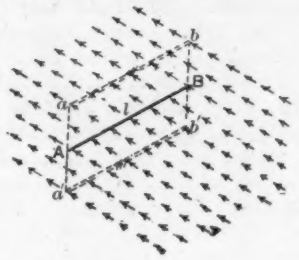


Fig. 50.

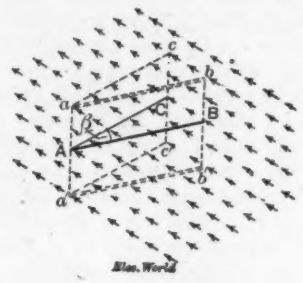


Fig. 52.

the flux, or its projection on the normal plane, so that the formula becomes,

$$e = \frac{\mathfrak{B}\, l\, v \cos \beta}{100{,}000{,}000} \text{ volts.}$$

If also the motion of the wire, instead of being directed perpendicularly to the flux, is such as to make an angle α, with the perpendicular plane, the effective velocity is that virtually taking place perpendicular to the flux, or $v \cos \alpha$, as shown in Fig. 53, so that the formula becomes in the most general case,

$$e = \frac{\mathfrak{B}\, l \cos \beta \,.\, v \cos \alpha}{100{,}000{,}000} \text{ volts}$$

It will be seen that in all cases the amount of flux cut through in one second, gives the value of the E. M. F. induced in the wire, and that the value of the E. M. F. does not depend upon the amount of flux that has been cut through, or that has to be cut through, but upon the instantaneous rate of cutting, and that the E. M. F. ceases the moment the cutting ceases.

73. If the loop A B C D, Fig. 54, be rotated about its axis OO′, and in the direction of the arrows, then, while the side C D, is ascending, the side A B, is descending; consequently the direction of the E. M. F. in the side C D will be oppositely directed to the E. M. F. in the side A B. Applying Fleming's hand rule to this case, we observe that the direction of these E. M. F's. are as indicated by the double-headed arrows, which, regarding the conductors C D and A B, as forming parts of the complete circuit C D A B, it is evident that the E. M. F's. induced in A B and C D, will aid each other, and, that if they are permitted to produce a current, the current will flow through the circuit in one and the same direction.

74. We have seen that no E. M. F. is induced in a wire unless it cuts through flux, consequently the portions B C and A D, of the circuit which move in the plane of the flux, will contribute nothing to the E. M. F. of the circuit.

If the dimensions of the wires forming this loop shown in the figure, are such that C D and A B, having each a length of 12

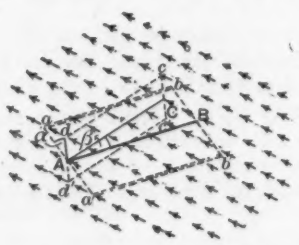


Fig. 53.

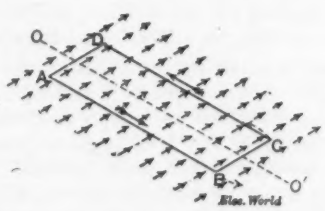


Fig. 54.

cms, while A B and B C, are 4 cms each, the circumference traced by the wires A B and C D, in their revolution about the axis, will be $3.1416 \times 4 = 12.567$; and, if the rate of rotation be 50 revolutions per second, the speed with which the wires A B and C D, revolve will be 628.3 cms per second. If the intensity of the magnetic flux, $\mathfrak{B}$, is uniformly 5 kilogausses, the E. M. F. induced in each of the wires A B and C D, will be, $5{,}000 \times 12 \times 628.32 = 37{,}699{,}200$ C. G. S. units of E. M. F., or 0.377 volt. This value

of the E. M. F. only exists at the instant when the loop has its plane coincident to the plane of the flux, and the sides cut the flux at right angles. In any other position the motion of these sides is not at right angles to the flux.

(To be continued).

A Dresden Electric Plant.

BY ROBERT GRIMSHAW.

One of the most interesting electric lighting plants in Continental Europe is that just completed in part in Friedrichstadt, Dresden, for the use of the government railways, under the supervision and from the plans of Prof. Dr. Ulbricht of the Royal Technical High School (Polytechnikum), Dresden.

The installation being one for the conversion of mechanical force into electrical energy, it is perhaps proper that the power generating department be first described. The general position of the plant with relation to the depots and tracks to be served and to the Elbe river may be seen in Fig. 1. A general view of the main building is shown in Fig. 2.

The boiler-house is a parallelogram 29 by 16 meters in plan and 8 metres high, with a trussed roof, and is intended to contain 6 compound boilers, of which there are already installed two (one serving as a reserve). Each of these is of the "two-story" type, consisting below of one horizontal cylinder 4.95 metres long and 2.0 metres in external diameter, and having 2 flues 4.95 metres long and 0.8 metres in diameter, and above of one horizontal cylinder 3.5 metres long and 2.13 metres in diameter, with 100 iron tubes, each 3.5 metres long and 0.09 metres internal diameter. The main shells are of wrought iron 16 to 20 mm. in thickness, and the system is tested to a pressure of 13 atmospheres by the gauge, the working pressure being 8 atmospheres by the gauge. The grates are inclined and steeped, and each has an area of $2 \times 1.5 = 3$ m². The fuel burned is soft Bohemian free-burning coal (gives about 4 kg of steam per kg coal) burning without coking or clinkering. The combustion gases after passing through the large flues below, reverse their course under the upper cylinders, and then pass through the flues to the stack. The entire heating surface of each double-deck boiler is 150

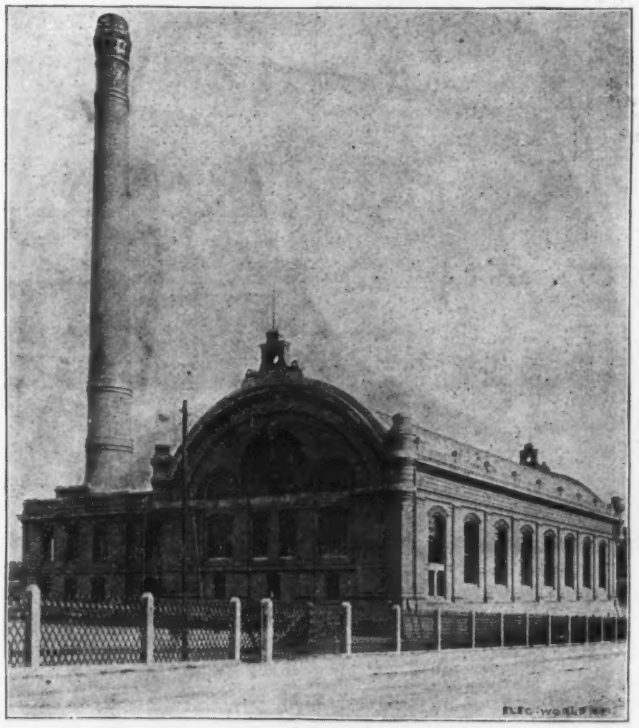


FIG. 2.—VIEW OF MAIN BUILDING.

square meters, giving a proportion of heating surface to grate surface of 50 to 1.

The feeding is by injectors, and an automatic device ensures that the water level in the upper shells (it is understood that there is steam space in both the lower and the upper story of each boiler) shall be kept constant and that the upper shells shall receive feed before the lower ones; that is, should there be low water, by any mischance, it will occur in the lower shells first. The glass water gauges are protected by semi-cylindrical shields of tough glass 10 mm in thickness, enclosing in its substance a strong wire netting—so that should the gauge glass break, the fireman will be protected by the strengthened shield while he closes the cocks communicating between the gauge glass and the boiler. There is a pointer to indicate the proper water level to be maintained in each shell.

The stack stands apart from the boiler-house, and is a handsome

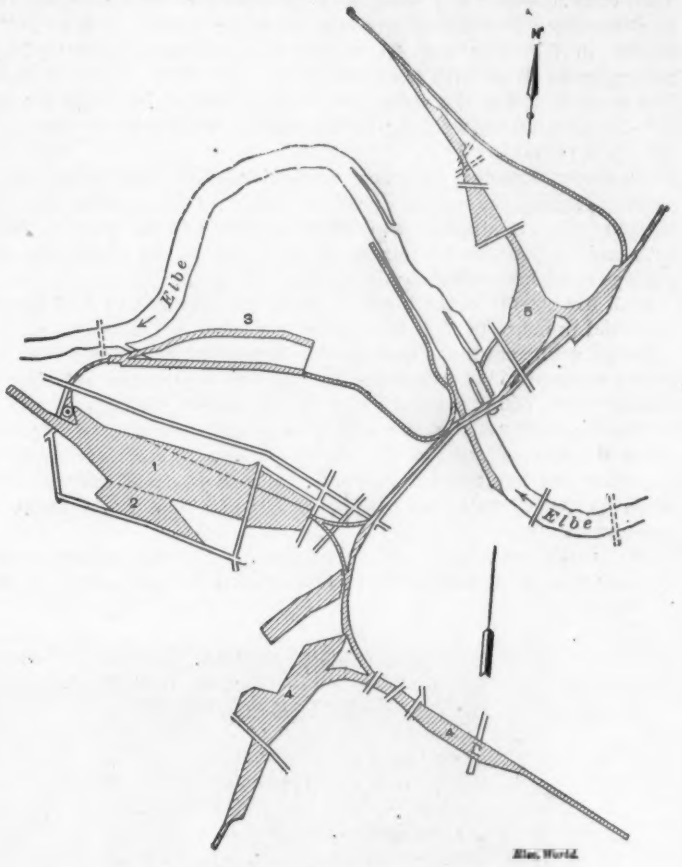


FIG. 1.—MAP OF TERRITORY SUPPLIED.

structure of yellow brick, 60 meters high, but from its fine proportions appearing much less. It is circular in plan, with a broad base; the flue is 2.9 metres in diameter at the base, and 2.6 metres at the top; the outer diameter of the shaft proper tapers from 4.5 metres at a distance of 16 metres from the ground to 3.25 just under the cap mouldings.

With the present slight demand for steam, the evaporation is only 1,480 kg of water per hour; this being accomplished from feed water at 10 degrees centigrade, with a fuel consumption of 1,500-kg without the water for combustion. The feed water is obtained from the usual supply for the city of Dresden, and contains but a slight amount of impurities, as it is derived from the sandstone strata which characterizes this part of Saxony. The supply pipes which lead from these boilers to the engines are of wrought iron with gentle curves instead of the usual cast iron "ells" and are covered with a non-conductor of heat.

The setting of the boilers is of brick. The ashes are removed by cars. All that portion of the boiler-house floor which constitutes the foot-way in front of the boilers (a strip 3.7 metres wide) is floored with tiles, giving a every neat finish. The coal is drawn from bins outside the boiler-house proper, but built against its walls, and is withdrawn through closely fitting iron doors, one in front of each boiler, so that the house remains neat and sightly.

The engine-room is also the dynamo-room. It is 44 metres long, 17 wide, and 10 high, with a gallery stretching across one end for the switchboards, ampere metres, etc. The roof is open and trussed. An overhead traveling crane permits handling the heaviest pieces with ease and convenience.

There will be eventually four engines, of say, 600 total hp; but at present there are but two, of which one is a reserve. These are directly connected to the dynamos. Each is a horizontal tandem compound condensing engine of a modified Proell drop cut-off type. The high pressure cylinder is 450 mm diameter, and the low pressure cylinder 750 mm, the stroke being .9 metre. There is a back rod to ensure stiffness and alignment of the pistons. The frames are of the girder type. The admission valves are vertical poppets on top; those of the high pressure cylinder being controlled

by the governor and those of the low being variable in admission period only by hand adjustment. The exhaust valves of both cylinders are plain slides, one for each end, and are underneath the cylinders so as to ensure good drainage.

The engines make 100 turns a minute, giving a piston speed of 180 metres per minute. The condensers are of the jet type, the circulating water being drawn from a masonry lined, stone bottomed pond constructed in the grounds of the plant for this purpose, and of a capacity of 4,000 cubic metres of water drawn from a well 4 metres in diameter and 15 metres deep, communicating through underground strata with the river Elbe, about 500 metres distant. The temperature of the water in this pond varies but sligthly from 25° C. At present, working 160-hp during nine hours of the night run, it is raised but 2° C.

An electric motor governor, adjustable from the switchboard, permits varying the engine speed at will. As the exciting dynamo of each main armature serves both armatures and the currents from both main armatures are joined before going to the converters, the engines must keep absolute time with each other.

With the cut-off in the high pressure cylinder at 0.28 stroke, and an initial pressure of 7.5 kilograms per square centimetre at the cylinder, each engine develops at 100 rotations per minute, and with a vacuum of 0.7 kilograms per square centimetre relative to absolute zero, 366 gross indicated horse-power, which amounts to 300 horse-power net, by the brake, (when the friction of the engines themselves and of the direct connected main and exciting armatures are deducted) to be converted into electrical energy. The output is 200,000 watts, showing an electrical efficiency of about 90 per cent.

The machines generate three-phased currents which leave the dynamo at a voltage of 120, which is increased in the converters to 3,000. Each dynamo is coupled with a continuous current exciting machine of 20,000 watts capacity; but the two three-phase machines are coupled together and the two continuous current machines also. The exciting current is of 110 volts tension.

There are at present three converters of the Siemens vertical type; there is space in the converter room for 15, and present provision has been made for the installation of nine. The transformers are in a room 8.2 × 14.25 metres square; they are insulated from the earth.

The maximum of energy now generated (October, 1894), amounts to but 100,000 watts, of which 80,000 watts are used for arc lights and 20,000 for incandescent lights. Eventually next year the current output will be 600,000 watts, of which 350,000 will be for arc-lights, 150,000 for incandescent lights and 100,000 for stationary motors. The arc lights are run with a voltage of 37 and the incandescent with 74; the arc light takes the current between the first and second and between the second and third wires, and the incandescent between the first and third.

Fig. 4 shows the division of the currents for lamps and motors; the lamps taking the difference between the first and third leads only; the motors taking that between the first and second and the third.

There is a Thomson electrostatic indicator to show if a ground connection occurs with each wire.

The cables carrying the current are triple, each having three 7-wire conductors, with gutta-percha between; then a lead pipe,

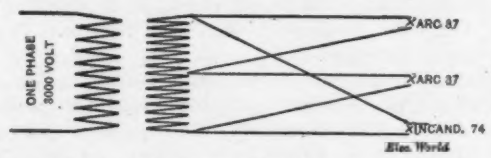


Fig. 4.—Transformer Connections.

then insulating and water-proofing composition, and then iron tape. The copper in the conductors will weigh about 40,000 kg.

The entire system of engines and dynamos is insulated electrically from the ground. The tension between the wires of the triple lead system is 3,000 volts; that between the wires and the ground 2,000.

Under the triple lead conductors there is stretched a network of two stout parallel wires connected at short intervals by wire cross-pieces, so that should a conducting wire break it would most probably fall on this network and be prevented from doing damages, as the circuit would be completed through this. Should an end project through the network, and come in contact with a person, the chances of the latter getting any but a very slight amount of current would be infinitesimal.

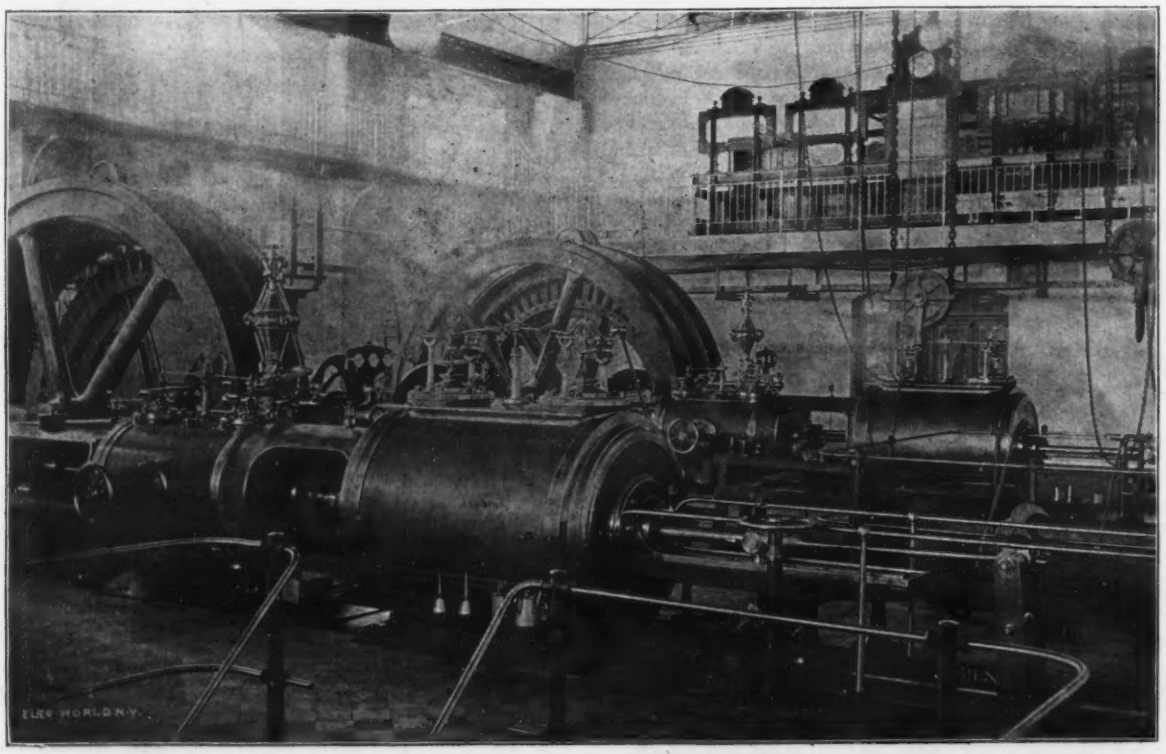


Fig. 3.—Engine and Dynamo Room.

There will be required about 800 arc-lamps with 200 to 840 watts consumption, 3,600 incandescent lights and about 350-horse power for motors; but of these last not all will be required at once.

The distribution of current is shown in Fig. 1, in which there are five sections; No. 1 for the switching depot, No. 2 for the workshops, No. 3 for the dock department, No. 4 for the main depot, and No. 5 for Newstadt. The entire demand for all five will be about 600,000 watts, of which a quarter will be needed for motors in the workshops, for cranes, track, etc. The district to be served is about ¼ of a million square metres; of which 4 per cent. is for depot and other platforms, and 12 per cent. for closed buildings. The greatest distance of service is 6 kilometres, the average is little over two kilometres.

Cost of Light and Power for the California Midwinter International Exposition.

BY W. F. C. HASSON AND A. M. HUNT.

The following data concerning the California Exposition and the expense connected with furnishing the necessary light and power may be of interest.

The exposition was located in a partially improved portion of Golden Gate Park. Three-fourths of the ground consisted of sand hills on which were a few clumps of evergreens and a grove of young eucalyptus trees. The remaining fourth was swamp land, and was afterwards converted into a recreation ground and plaza for fireworks and athletic and equestrian entertainments.

The citizens of San Francisco contributed $331,000 to the Expositon fund. The original concession from the Park Commissioners was less than sixty acres. This grew to one hundred and sixty acres without a corresponding increase in subscriptions. Notwithstanding the fact that the Exposition had no aid from the general government, state, county or city, not only were all obligations met, but a sufficient surplus remained to leave a large portion of the park permanently improved, and also a public museum and art gallery.

The distance from the dynamo to the electric fountain was 460 ft. and to carry the current for the fountain lights, ten 4-0 cables were necessary. The distance from the dynamo to the base of the electric tower was 680 ft., and to carry the current for the tower lights, twelve 4-0 cables were used. Minute economy in every department was necessary, and expensive underground ducts were therefore out of the question. The duct for these underground cables was built of ordinary planks, the outside dimensions being 6 inches by 4 inches, and the inside 4 inches by 2 inches. A continuous strip of P. &. B. roofing paper was laid the entire length of the duct, the cables placed in position, the paper folded over, and both edges finally secured in position by the cover of the duct. Although a large portion of the duct was under a lawn continuously saturated with water, no trouble whatsoever arose from this source. A large portion of the wire used was 4-0 cable that had been in use at the World's Fair. This wire on removal was found to be in such excellent condition that it has been sold for interior wiring for 60 per cent. of its original cost.

The ducts for underground wires for arc lights consisted of 2 inches by 4 inches rough lumber in which there was a 1 inch by 1 inch rabbet.

Lamp poles were turned 8 inches diameter at base and 5 inches at top; height 12 feet to 14 feet. Wires were carried in a groove that was closed with a fillet. Around the Grand Court, arc lamps were spaced 30 feet and 35 feet. On roadways, 50 feet and 75 feet.

For cornice lighting a 500-volt Edison railway generator was used. Lamps were wired in series of five and multiples of ten where the construction of the building would permit.

Edison lamps were the ones used throughout. The wiring was so arranged that the lamps on buildings nearest the power station were 117 volts; those half way around the court 115 volts; and those most distant, 113 volts.

For all accessible places 16-cp lamps were used. For places difficult of access; on domes and minarets, 20 and 24-cp, 120 volt lamps were used. This policy proved to be an excellent one, as the renewals in these places were merely nominal.

The wiring for the cornice lights was done by contract by the General Electric Company. The sockets were in place several days before the lamps were placed in position, and through the carelessness of the inspector of wiring a great number of lamps were allowed to be placed in sockets partially filled with water. The first test of the decorative cornice lighting resulted in a dismal failure. The lamps were then removed, the sockets cleaned, and new lamps placed in position. Satisfactory results were obtained for a few days. When, after a heavy fog, a large number of lamps were found to be inoperative, examination showed that in many cases the leading-in wires had been destroyed by electrolytic action. Lamps that were found to be in good condition were then thoroughly dried at a temperature of 300 degrees F, and the bases immersed in a bath of boiling paraffine. These lamps when placed in use withstood the weather perfectly, and the number of renewals became nominal.

The construction work of the Electrical Department, briefly stated, was as follows:

Length of underground circuits installed	17,560 feet
Length of main pole line constructed	9,000 feet
Lamp poles for roadways	371
Incandescent lamps—wiring for	1,800
Total length of wire installed	199,267 feet

The construction work of the Mechanical Department consisted of the unloading and handling of all machinery, the erection of all engines except two, the hanging of all shafting, the supervision of installation of all boilers, piping and pumps for fountains, &c.

The Mechanical Arts Building was so poorly designed for the purpose for which it was used that considerable labor and expense was necessary to put it in proper condition.

The Chief of the Engineering Department was also Chief of the Department of Mechanical Arts, which added greatly to the office expenses of that Department.

Following is some data relating to the Exposition grounds and structures:

Area enclosed in the Exposition grounds	160 acres
Length of roadways	12,500 feet
Number of buildings	120
Buildings supplied with electric light	63
Height of Electric Tower	262 feet
Dimensions of Grand Court	1,000x500 "

The power furnished for Exposition purposes was as follows:

56 arc lights Mechanics Arts Building.
141 " " Manufacturers and Liberal Arts Building.
112 " " Horticultural and Agricultural.
98 " " Grand Court.
160 " " roadways, etc.
42 " " patrol circuit.
1,788 incandescent lights Exposition buildings and offices.
2,256 " " cornice lights.
3,213 " " Electric Tower.
1 60-inch search light on Electric Tower.
1 30-inch " " for Mechanics Arts Building.
19 small " " for Electric Fountain
3 pumps for electric fountain.
2 " " Statuary "
Line shafting.
Fire pumps.

Incandescent lights furnished to the Exposition	7,256
" " sold	1,876
Total incandescent lights	9,132
Ratio of total lights to lights sold, 4.86 : 1.	
Arc lights furnished to the Exposition	609
" " sold	182
Total arc lights	791
Ratio of total lights to lights sold, 4.34 : 1.	
Receipts for sale of light and power	$26,279 00

The machinery used for supplying power was as follows:

8 Heine boilers of 375-hp each.
1 Russell engine driving four 50-light T.-H. arc dynamos.
1 Buckeye " " four " " " " "
1 Payne " " one " Standard arc dynamos.
1 N. Y. Safety " one " Wood " "
one 60-light " " "
1 Ohmen " " three 50-light Standard " "
1 Ball " " two " Western Electric arc dynamos.
1 Thompson " " one " " " " "
1 Taylor-Beck " one " " " " "
1 Hamilton-Corliss engine driving one 300-kw T.-H. A. C. generator.
1 Pitchford " " " " 150-kw Wood " "
1 Union Iron Works engine driving two 150-kw Western Electric D. C. generators.
1 Thompson-Corliss engine driving one 150-kw Edison D. C. generator.
1 Hendy engine driving one 200-kw Edison railway generator.
1 Putnam engine driving two centrifugal pumps for statuary fountain.
2 Hendy " " shafting.
3 Dow fire pumps.
3 Dow pumps for electric fountain.
3 Dow feed pumps.
1 Smith-Vaile feed pump.
1 4,000-hp Webster vacuum heater.

The cost of material and labor for the installation of the machinery was as follows:

Erection of boilers, pipes, pipe-covering, etc	$17,594 33
Concrete foundation and foundation bolts, for 14 engines and 6 pumps	4,459 09
Belting, shafting and sundries	2,605 89
Riggers	573 00
Office, wages and pay roll	3,787 19
Total	$29,019 50

The cost of labor, material, etc., for fountains was as follows:

Electric Fountain:		
Total expense for rental and installation of pumps, purchase and laying of pipes, all pump connections, and construction of flume and tank	$13,692 72	
Statuary Fountain:		
Total expense for pipes, connections, etc	1,659 89	
	$15,352 61	
Wiring:		
Three main buildings for 307 arc lights	990 90	
For 2,160 exterior and 1,587 interior incandescent lights	3,997 00	
	$4,987 90	
Rentals:		
Paid for use of boilers, engines, dynamos, wire pole-hoods, etc	$17,528 20	

The cost of material and labor for the installation of the electric plant was as follows:

Wire	$6,056 92	
Sundry materials	2,701 58	
Foundations for dynamos	593 47	
Office, wages, salaries, etc	5,709 40	
		$15,061 37

The following was provided for by special contract:

Electric Fountain:	
Contract for erection, rental and operation of same except splash basins, piping, pumps, etc., included in other statements	$21,000 00

Electric Tower:		
Contract for rental of machinery, wiring of tower, operation of machinery and maintenance of lamps		22,745 00
Search Light:		
Erection of search light	$87 50	
Material for operation	67 05	
		$154 55

The cost of operation of the plant from January 27th to July 9th, 1894, was as follows:

Engines and Boilers:		
Coal, fuel and lubricating oil		$30,007 95
Tools, supplies and repairs		1,886 93
Office, salaries and payroll, including all expenses for office, janitors, etc., connected with Mechanics Arts Building		13,680 50
		$45,575 38
Electric Plant:		
Carbons	$1,513 50	
Incandescent lamps	2,072 20	
Tools, supplies, etc	987 61	
		$4,573 31
Salaries:		
Office	$717 00	
Inspection	359 33	
Wages	9,257 05	
		10,333 38
		$14,906 69

The total expense of installation and operation was as follows:

Installation of engine plant	$29,019 50
Erection of fountains	15,352 61
Wiring contracts	4,987 90
Rentals	17,528 20
Installation of electric plant	15,061 37
Operation of engines and boilers	45,575 38
" " electric plant	14,906 69
Contract electric fountain	21,000 00
" " tower	22,745 00
Expense for search lights	154 55
	$186,331 20

The average daily load during the month of June was distributed as follows:

Arc light machines	2,156	horse-power hours
A. C. incandescent machines	2,462	" "
Electric Fountain generator	2,805	" "
Railway generator, light and power	2,770	" "
Generators for Electric Tower lights	810	" "
Fountain pumps, electric	233	" "
" " statuary	480	" "
Fire pumps	600	" "
Feed	442	" "
Shafting	160	" "
Starting	110	" "
Total daily load	13,026	" "

Gallons of oil consumed per month	130,200
" " " " day	4,340
Weight of oil " " " "	32,116 lbs
" " " " " hp hour	2.465 lbs
Cost per lb of oil at $1.75 per bbl	.56 cts.
" " indicated horse-power per hour of engines	1.3804 cts.
Percentage of load for incandescent lights	28.2 per cent
Cost of fuel for incandescent lighting per month	$1,520 99
Cost of fuel per incandescent lamp per month	16.5 cts.
Charges per incandescent lamp—period of Exposition	$8 00
" " arc " " " " "	75 00
Period of operation, January 27th to July 9th, 1894:	
Hours of incandescent light service	1,937
Days of arc light service	154
Number of Electric Fountain displays	252

The cost per 16-cp lamp for the period of the Exposition was as follows:

Freight on electric machinery	$ .40
Installation of dynamos	.05
Attendance of dynamos	.21
Installation of wiring	1.20
Inspection of wiring	.05
Patrol and maintenance of circuits	.03
Lamps and renewals	.30
Office expenses, Electrical Department	.06
Total, Electric Department	$2.30
Installation, engines, boilers, piping, belting and rentals	$1.32
Fuel	.82
Attendance, engines, boilers and pumps	.285
Oil, waste, etc	.01
Office expenses, Engineering Department	.05
Total, Engineering Department	$2.49

The total expense therefore, of rental, installation, operation and maintenance of boilers, engines, piping, belting, dynamos, wiring, lamps, etc., per 16-cp incandescent lamp for the period of the Exposition, was $4.79.

In considering the cost of operation, it must be borne in mind that the lighting plant was in no sense well designed for economic operation. Both engines and dynamos were operative exhibits that had to be matched as well as circumstances would allow.

The installation of all parts of the plant was attended with undue expense, on account of the chaotic condition of affairs incident to the necessarily rapid construction work of all departments of the Exposition.

The entire plant was of necessity regarded as an emergency plant, and so operated. The economic attendance of dynamos and engines was thus out of question.

In making the preliminary estimates of the allowance to be made for cost of lighting plant, it was found impossible to get any figures of a plant under similar conditions except the contract for lighting the World's Fair.

The results given in this article are those that were actually obtained, and it would appear that they should be of value in estimating the probable cost of work of similar nature.

It is now certain that if all construction work had been done by the Exposition forces, the cost of construction would have been reduced about thirty-five per cent.

The Best Method of Treating Accidents.*

BY P. M. DYER.

It is my purpose to explain to you in what manner the North and West Chicago Street Railway Companies attend to personal injury cases, commencing with the accident and following the theme to the final disposition of the claim. These two corporations carried 167,000,000 passengers during the year ending December 31, 1893, and upon the claim department devolves the duty of investigating all accidents and the making of settlements, or preparation of the defence, in all claims that spring from this great traffic. One claim department does this work for both roads.

The working force consists of a medical staff and a sufficient number of investigators, all under the direction of the chief adjuster, who reports to the general counsel of the two companies. For the purpose of this article the work of the claim department may be divided into three periods, each separate and distinct from the others, as follows: First, investigation; second, negotiation; third, litigation.

First, as to investigation. The work of this period begins immediately after the accident and continues until there has been secured a full and accurate account of the accident, with reliable information as to the nature and extent of the injuries to person. Employees have been instructed to notify the claim department of the occurrence of an accident on car or train, giving circumstances of the same, nature of injuries to and residence of the injured, and as far as possible to secure the names of the witnesses. When this has been accomplished and the injured one has been placed in the charge of a physician or the police, the car or train may continue its journey. In the meantime a representative of the claim department will proceed with all possible dispatch to the scene of the accident. If the injured person has not yet been removed, he must see that conveyance is provided to the hospital or to the home.

These companies usually bear the expense of temporary medical care and transportation, without regard to liability, believing such attention is appreciated by the injured and the community at large. In all cases of personal injuries, it is the duty of the medical staff to secure the privilege of an examination; the physician making the same to avoid any assumption of responsibility for the treatment but to fully ascertain the nature and extent of the injuries, and to obtain, if possible, a concurrence in his report by the attending physician.

All employees witnessing accidents are required to make written statements of the circumstances of the same on printed forms provided for that purpose, attaching the names and places of residence of all witnesses. This report must be completed and given to the foreman before the employee finishes his day's duties. These reports are forwarded to the claim department without delay, and when received, circular letters containing printed interrogatories are sent to each witness. If the seriousness of the accident demands it, interviews are had with the witnesses. That the claim department may be kept fully advised from time to time as to the condition of persons injured on these roads, they are occasionally visited during the period of recovery by the investigators assigned to those cases. In Chicago all hearings before the coroner are had immediately after the accident, and the verdict of the coroner's jury is usually rendered on the day following the death. It is the policy of these companies to secure the presence of their witnesses at the hearing before the coroner, and obtain stenographic minutes of the proceedings. Thus, in a comparatively short time, the claim department will have collected much information as to the condition of the injured and the circumstances of the accident. We may now consider the work of the first period completed.

The reports relating to an accident could now be filed away, perhaps forever, if it were not for the industry of some claim lawyer or other hustler who persuades the injured to make a demand on the company for compensation. The making of a claim leads us to a consideration of the second period, that of negotiation. Demand being made for compensation, it becomes the duty of the chief

*A paper, slightly condensed, presented at the Atlanta meeting of the American Street Railway Association.

adjuster to place before the general manager or general counsel all facts within his knowledge bearing on the claim, for a decision as to liability, and the naming of the maximum sum to be paid, if a settlement is deemed advisable, the claimant being promptly informed of the decision. As to the negotiations preceding a settlement, I need say but little. They are usually conducted by the chief adjuster on the part of the company. If not successful the period of negotiation will end, usually to be followed by litigation, the third and last.

After the commencement of suit all witnesses are again located by the claim department, and thereafter located at stated intervals until the time of the trial, and if possible additional witnesses are found to strengthen the defense. Success in defending suits arising from personal injuries, largely depends on the character of the work done during the period of investigation. The officers of these companies believe in the thorough investigation of all accidents, if possible the settlement on a reasonable basis of all valid claims, in vigorously contesting fraudulent demands, and that prompt settlements are for the best interests of their companies.

In conclusion, I will say that the time is at hand when all railroad corporations must be prepared to resist claims in a large percentage of their accidents. To promptly prepare to do this is the part of wisdom, when considered from a financial standpoint, usually the determining consideration in corporate management.

Power-Brakes vs. Hand-Brakes.

In a paper on the above subject, read at the Atlanta Convention by Mr. E. J. Wessels, the inadequacy of the hand-brake for street railway work is strongly insisted upon, particularly on roads with grades. Duplicate hand-brakes, sometimes fitted where there are heavy grades, are condemned, owing to the wear and tear on apparatus, short life of shoes and retardation of speed.

It is stated that the braking force requisite to bring a car or train to a stop, should never exceed the weight of load resting upon the wheels to which brakes are applied. Any power applied in excess of this is wasteful and dangerous. The full power of a friction brake depends upon the load carried on axle to which friction discs are attached. For example, with grip car and passengers weighing 8,000 pounds, the weight being equally divided between two axles, 4,000 pounds are carried by the axle with friction discs. With car wheels of two and one-half times the diameter of the friction drum, that much leverage is gained, which, multiplied by 4,000 pounds, gives 10,000 pounds as the direct pull power of the friction brake. The brake levers of street cars are as a rule adjusted to about four and one-half times leverage. If, then, the 10,000 pounds pull of friction brake is multiplied by this leverage there is a strain of 45,000 pounds upon the brake beam and shoes. This is vastly more power than is ever required. When two or more cars are coupled together it is impossible to regulate brake chains and brake gear so that every shoe will press with equal force against the wheel. When, therefore, a gripman applies a friction brake, the entire 45,000 pounds is carried by the beam and shoe that are adjusted nearest the wheels and the remaining wheels revolve without noticeable check.

In a train of three four-wheeled cars with passengers, weighing 36,000 pounds, resting on twelve wheels, a brake power of say 2,900 pounds applied to each wheel would make the most perfect stop. If the entire 45,000 pounds power of friction-brake is applied to only two wheels of such a train, there will be 38,000 pounds more power exerted than necessary to stop the wheels from revolving, and at the same time only one-sixth effectual braking power is obtained as compared with a braking pressure distributed against every wheel under the train. Such harsh, rigid, excessive power of the friction brake, applied quickly by the momentum of the whole train, will wear out any kind of brake gear, no matter how good or how strongly made, and the constant jar adversely affects the life of cars. In cold, wet and stormy weather (with slippery tracks), when the grip car is abandoned except by the gripman, the pull power of the friction drum is greatly reduced just at the time it is most needed to set brakes on trailers, which are always overcrowded at such times. A twenty-eight foot closed electric car weighing, without passengers, 20,000 pounds, and running at ten miles per hour, has over six times the energy to overcome when brakes are applied that a horse car has weighing one-fourth as much and traveling at less than one-half the speed. Moreover, when horses were employed there were ten feet extra length in which to stop the car. This extra length is no longer available since the advent of electric cars. Unless cars have proper brakes high speeds are therefore most dangerous.

The great muscular strain with hand-brakes gradually tires out the brakeman, so that after a few hours' handling of a grip lever or controller handle, he finds his strength decreasing. Realizing this, for the rest of the day the brakeman slows up earlier than strictly necessary, or (as often happens) does not stop at all and lets cars run past crossings, missing passengers, who do not always wait for the next car, but walk instead. If, however, the brakeman has ready for instant use an ally in the shape of power requiring but the touch of a handle to become available, he is placed in the best possible position to make as many stops in as short a distance as is necessary. Not being fagged out, he is better able to do his company more justice and is more on the alert to prevent accidents.

Probably seventy-five per cent. of recorded accidents is chargeable to inefficient brakes. Statistics of this sort are hard to tabulate, and some records show even a higher percentage. While hand-brakes often stop cars quickly, they do so by consuming excessive energy. This means waste and increases the maintenance account. Then, too, it is impossible for a motorman to maintain his maximum strength for a long time. In active service he has to apply brakes between 250 and 400 times daily. He can only exert his maximum strength spasmodically and temporarily, even when aided by the weight of his body.

Hand-brakes, unlike power-brakes, have no emergency stops; and it is necessary to have a separate brakeman for each trailer, while with a power brake only one motorman and one conductor is necessary for a motor car and two trailers, which, in this case, means a saving of $21 per week, or sufficient to soon pay the cost of an air-brake equipment.

Air-brakes are provided with reserve power stored in reservoirs, and, by having large enough capacity, the air pressure required for braking becomes practically inexhaustible. The air pump of a thoroughly good air-brake is most economical in operation. I requires no power when the car is starting or when it climbs grades. As it takes ten times the power to start a car that it takes to keep it going, the advantage of this is obvious. A good air-brake is so compact that very little room is required for it under car body. It has no cumbersome or complicated machinery to get out of order. It works automatically. It needs much less attention than an electric motor gets. It is only necessary to keep the mechanism clean and in order, and to lubricate the pump regularly. No hinges or springs annoy inspectors or employees. A good air-brake pump, the moment it has compressed sufficient air, cuts out and runs in free air with the axle. A good air-brake entirely replaces a hand-brake. The hand-brake may be left on the car, and the air-brake can be so attached as to leave the hand-brake available should it be required. A good air-brake requires no expert to operate it. It is so simple that a child can work it. This being so, a railway manager is not restricted to hiring men of a certain height or weight, for when work is done by compressed air instead of muscular strength, no Samson is required to work the handle. A good air-brake enables a man to make the best possible stops without noise, jar or injury to apparatus. In hand-braking much excess force is used. This means that rods and bars are strained when stopping car, and often brake gear is in such shape that, when a quick stop is required, some part is sure to collapse.

The all important question is whether the first cost of a good air-brake is too high, or not, in proportion to the advantages gained. No accountant can figure accurately how many dollars of damage claims will be avoided; nor how much revenue will be increased by the quicker schedules made possible with air-brakes (for even seconds count); nor what the gain in labor account will be by not being restricted to hiring any particular height or weight of man; or how much the life of car body, truck and motor will be prolonged. There is a decided gain from whatever point the air-brake is viewed.

Curious Coincidence.

An English minister, in a sermon in which he spoke of the growing disinclination to believe in anything that could not actually be seen, made the following remark: "There are things around us which we cannot see, although we are sure they are there," at which moment all the electric lights in the church went out.

The Age of Niagara Falls.

According to some calculations made by Prof. J. W. Spencer, the human race has for 31,000 years been neglecting the dynamical possibilities of Niagara Falls, and will have only another meagre 5,000 years in which to make up for lost time.—The London "Electrician."

Destructive Arcing of 500-Volt Fuses.*

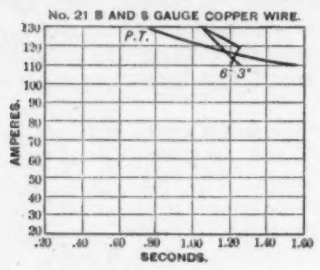
BY W. R. HARRINGTON.

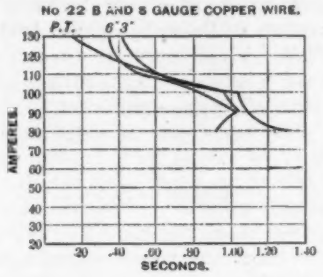
A series of carefully conducted tests were made to find the relation between the fusing currents of different copper wires, ranging from No. 30 to No. 21, B. & S. gauge, the time required to open the circuit, and to what extent the arc contributed to the time required.

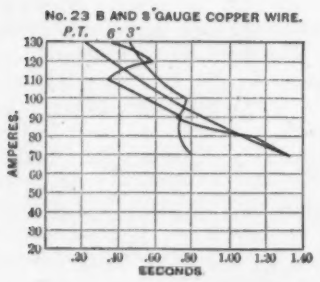
The tests were conducted across the bus bars of switchboard of the Camden Horse R. R. Co., Camden, N. J. Average voltage, 515 volts.

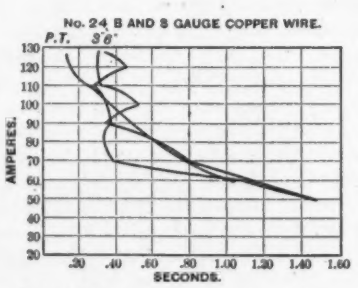
Before throwing a fuse in circuit, a water rheostat was set, using a Weston ammeter for this purpose, so that the current desired would flow through the fuse, when the circuit was completed by the traveler on the trackway. The different sized fuse wires were subject to the following limitations: the time of the traveler running full length on the trackway 1.5 seconds; current ranging from 20 to 130 amperes in 10 ampere steps.

The smaller fuse wires would fuse with the minimum current of 20 amperes, and in all instances inside of the 1.5 arc limits. Consequently, the curves show a wide range, but in the larger sized, wires, a greater current was required to fuse the wires in the 1.5 second limitation; therefore the curves given for the larger fuse









FIGS. 1, 2, 3 AND 4.

wires show less and less range as the fuse wires increase in size.

In order to strike an average, the tests were repeated under similar conditions as regards current and gauge wire with a 3″ horizontal fuse, a 6″ vertical fuse, both of which were connected to a standard form of fuse block; also a 4½″ fuse, the average in length of the 3″ and 6″ was employed; connected in a specially constructed fuse block, which absolutely prevented any arcing of the terminals. In other words, the fusing of the fuse wire could not burn the terminals to which it was attached.

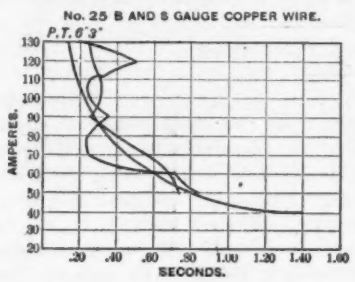
The results recorded graphically in the following charts give, therefore, the time required in fractions of a second for the circuit to be opened under identically similar conditions as regards current and gauge of wire for a 3″, a 6″ unprotected and a 4½″ protected terminal fuse. The curves as given in chart No. 8 for No. 28 B. & S. copper wire, illustrates excellently the erratic character of the fusing of wire under conditions as observed in the practice of today.

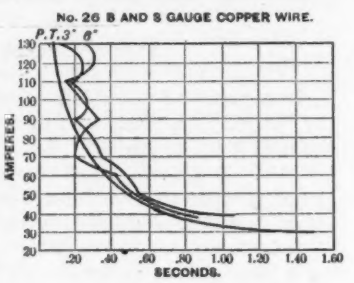
The time required to open a protected terminal fuse wire becomes less and less as the current increases and grows less regularly, showing that a regular law is followed. The curve is an hyperbola having its asymptotes for its axes, and the equation for it is $xy=13$ for No. 28 copper. Whereas, the two unprotected terminal fuses are uncertain, and show in a very pronounced manner wherein the terminals contribute to this end; the conclusion one is forced to draw is that a fuse wire in practice, when it fuses, does not do as it was intended to, open the circuit, but establishes a condition, though the time may be limited, wherein the terminals act as a magazine to furnish the gas through which the circuit is continued. The curves throughout do not show any superiority of the 6″ fuse over

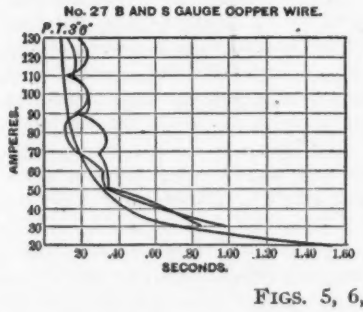
*A paper, slightly condensed, presented at the Atlanta meeting of the American Street Railway Association.

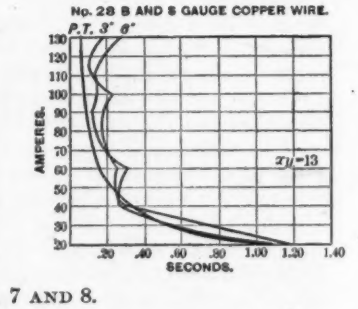
the 3″. Looking at the results in comparison with those of the Board of Fire Underwriters, the very point they should have observed was overlooked, to wit, the continuance of the arc through but a short period of time, at the expense of the terminals, and the possibility of the vicious gas thus generated, coming in contact with other circuits and establishing other and more serious conditions, such as short circuits and possible fires. Not to be misunderstood, while the tests as are herein recorded show no superiority of the 6″ unprotected terminal fuse wire over the 3″ unprotected terminal fuse wire, the 6″ fuse wire is unquestionably safer when conditions are more extreme, such as, for instance, when a short circuit occurs.

The determining factor in this matter of fuses is: What are the conditions required to protect against absolute short circuits across the bus bars of a large power station 500-volt switchboard? Tests are conducted showing how fuses act under conditions that are predetermined, certain currents which are made to flow, etc., but you never see anything published or advice given in this matter of fuses for the condition which really occurs the most frequently, that is, absolute short circuits. The Board of Fire Underwriters' Report gives the different length fuse blocks required for 10, 20, 30, 40 amperes, and so on. Now the requirements and limitations as prescribed in their report are true and perfectly safe when the fuse





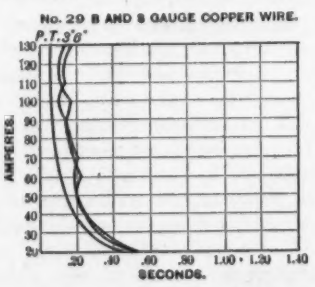


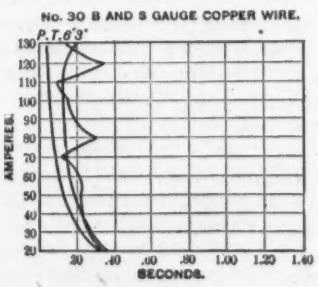


FIGS. 5, 6, 7 AND 8.

"blows" under the conditions outlined in the tests, as made by the committee appointed to make such tests. But on this absolute short circuit across bus bars, as above stated, a 10-ampere fuse block constructed as specified, will, instead of protecting one when most in need of such protection, burn up in the most vicious way, and will open magnetic cut-outs in a power station requiring currents up to 1,000 amperes to open. The fuse does not itself do this, but the arc established at the expense of the terminals is the immediate and sole cause, and the circuit must be opened elsewhere.

The conclusions one is forced to draw from the above tests and





FIGS.—9 AND 10.

the general literature upon the subject of fuses, are as follows: (1.) The proper and only fuse block to be used is one having protected terminals. (2.) That fuse blocks should be furnished so that the terminals would not be burned under conditions approaching an absolute short circuit across the bus bars of a 500-volt power station. (3.) That magnetic cut-outs are immeasurably preferable under all circumstances.

What Shall Be the Measure of Phase Difference?

To the Editor of The Electrical World:

Sir:—In their letter to The Electrical World of October 20th, 1894, Siemens & Halske touch upon a matter of importance that has heretofore received very little attention. They say "it is to be observed that with curves differing from the sine form the diagram constructed for the combination of currents does not give accurate values, as this diagram is only correct for sine form curves. Hence, we cannot replace non-sine curves by so-called equivalent sine curves, that is, curves having the same mean square and which give equal values as one special sine form curve. For example, for an E. M. F. curve whose amplitude was 1.120 of the mean value of the E. M. F., we have the results given in the table above:"

	Mean E. M. F.		Amplitude.
	Observed.	Estimated.	Observed.
Simple curve.....	100	.....	1.130
Sum of two curves differing in phase 120°.....	108.5	100	1.982
Difference between two curves differing in phase 120°.....	167.2	173.2	1.303

The phase difference of 120° is evidently the difference between the zero values of the alternating E. M. F.'s and not the actual difference of phase of the E. M. F.'s. taken as a whole. I construct a diagram for the sum of the two E. M. F.'s 100 + 100 = 108.5 used in making the measurements reported in the above table, and find the difference is 113°. I now assume that this is the correct angle and proceed to estimate the difference of the same two E. M. F.'s. I do this graphically by constructing a diagram for 100 — 100 at 113° difference of phase, and obtain as an estimated result 167.4 volts, while Siemens & Halske find by direct measurement 167.2 volts, an entirely practicable agreement. The phase difference for all forms of alternating current and E. M. F.'s should be stated for the entire values of current and E. M. F. instead of for the attainment of particular values and used as such. It seems to me that this is reasonable and convenient for all practicable purposes. A short time ago I had occasion to check the utility of this designation of phase differences for irregular curves with the following method and results: The measurements were made to determine the core loss of a 30-light 1,000-volt-50-volt transformer. A non-inductive resistance was placed in series with the transformer primary. The primary terminal where this resistance was placed was connected to one terminal of the secondary in such a way that the fall of potential produced by the primary leakage current, through the non-inductive resistance and the secondary E. M. F., would be added. The fall of potential, secondary pressure, and the sum of the two were observed with a multicellular electrometer. The value of the non-inductive resistance was 608 ohms; transformer primary turns 640; secondary turns 33; ratio of turns 19.4.

Observed Values.		Calculated.	
Fall of potential.....	50.5 volts.	Primary pressure.....	1,100 volts.
Secondary pressure....	56.7 "	Primary current.....	.083 amps.
Sum of these.....	99.3 "	.....	.....

The diagram for 50.5 + 56.7 = 99.3 gives a phase difference of 44.7°, for which the cosine is .71.

Apparent watts taken up in the primary, 1,100 × .083 = 91.3.

Actual estimated power taken up in primary, 91.3 × .71 = 54.8 watts.

A pressure of 56.7 volts was then applied to the secondary through a standard Weston wattmeter with the primary on open circuit at the same periodicity as that at which the above measurements were made, and the power taken up was observed to be 65.0 watts. This power determination is made where none of the E. M. F.'s and currents are sine forms, the primary current differed most widely from the sine form. Furthermore, analysis shows that this use of phase difference is convenient and entirely usable.

I agree otherwise heartily with the well placed arguments of Siemens & Halske in favor of the general utility of sine forms of E. M. F.'s.

HARRIS J. RYAN.

Ithaca, N. Y.

Reactance.

To the Editor of The Electrical World:

Sir:—In your issue of October 20, you express a hope that the definition of reactance may be thoroughly ventilated and discussed. As adopted by the American Institute of Electrical Engineers and used by Messrs. Steinmetz and Bedell, reactance means the ratio in an alternating current circuit of the quadrature component of the electromotive force to the current. As proposed by the Société Internationale des Electriciens, and used by MM. Hospitalier and Blondel, reactance means that quantity the square of which added to the square of the resistance of a circuit traversed by a periodic current gives the square of the apparent resistance. It appears to me that the former definition is preferable, for the former defines directly by means of a physical property, whereas the latter defines indirectly by means of an algebraic expression. The former has also the advantage of including the latter as a special case.

M. Blondel objects that the general idea is no longer that of a constant, and therefore is not properly denoted by an *ance* word; but in his own less general idea the thin edge of the variable has already entered in the form of the period and type of the wave.

So far from its being a defect of the more general definition that it unites under one word "un amalgame complexe et hétéroclite de toutes espéces de réactions," that appears to me to be its excellence, for they are united by an important physical bond. The definition is a physically real definition.

It is true, as M. Blondel points out, that the more general definition of reactance logically involves a more general definition of resistance, namely, the ratio of the co-phase component of the electromotive force to the current. The qualification "apparent," no longer required to express impedance, would appropriately distinguish the more general from the ohmic resistance; but it does not follow that it would be necessary to distinguish the more general from the less general reactance. The qualification "apparent" suggested by M. Blondel appears to me to be more correct than the qualification "equivalent" suggested in their letter by Messrs. Houston and Kennelly.

ALEXANDER MACFARLANE.

Ithaca, N. Y.

Fly Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir:—I cannot refrain from making a remark or two on the now popular subject of fly-wheels. The only danger that I can see in the case of short circuits is that of wrecking the spokes due to the cantilever strain placed upon them by the inertia of the rim. Of course after these are gone the rest follows. I cannot approve of building a fly-wheel in sections any more than is necessary for convenience in erection. The spokes have practically no stress other than traverse and the rim none other than that of tension. It seems to me therefore foolish to weaken the rim by joints any more than necessary. With perhaps the exception of belt driving fly-wheels where there is possibly slight compression on the spokes these stresses are exactly those which cast iron should not be called upon to bear, especially in modern high speed fly-wheels.

It is folly to attempt to strengthen the fly-wheel by thickening the rim for the stress increases in direct proportion to the cross section, so that the stress per square inch is stilll the same. A stronger material, not a different design, is the solution of the problem. Turning to the other material, wrought iron and mild steel, we at once see that a cast fly-wheel is out of the question. Sheet iron fly-wheels have been built with a solid web and pieces bolted onto the rim. But the ideal fly-wheel will not be made till a solid disc with flat endless iron or steel rings bolted or riveted on to either side of its periphery is produced.

Providence, R. I.

GEORGE T. HANCHETT.

Patent Office Systems.

In referring to the decision regarding the Edison feeder and main patent, the London "Electrical Rev ew" says "what a commentary on the boasted perfection of the examination system of the American Patent Office! It seems that with all the expert examiners, interferences, references, and the other elaborate machinery necessary to carry on this patent office, that a patent can be obtained without an invention. . . . It clearly points to the futility of examination, and proves what we have always held, that it is vexatious, expensive and useless."

DIGEST
OF CURRENT TECHNICAL ELECTRICAL LITERATURE
COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS
BY CARL HERING

ELECTRO-PHYSICS.

Light from Electrical Oscillations.—A translation of the paper by Mr. Ebert, under the title of "Persistent Electric Oscillations and their Effects," abstracted in the Digest Oct. 6, is published and discussed editorially in the Lond. "Elec. Rev.," Oct. 12, a full reprint of which will be found in another column. In the editorial discussion it is stated that the article deserves careful consideration by electrical engineers; "we fear it must be admitted that the electric light as at present produced, has no prospect, as far as regards cost of production, of competing with gas or oil;" referring to the experiments of Langley and Very in 1890, with the light of the firefly, it is stated that they showed that this light was produced at one 400th the cost in energy at which it was produced in the candle flame and at an insignificant fraction of the cost at which it was produced in the electric light. The first requisite for further advance in this direction is the invention of a high frequency transformer which will be small enough to be connected with each lamp; Tesla has shown that these currents are not dangerous and the absence of heat would increase the advantages over the present system.

UNITS MEASUREMENTS AND INSTRUMENTS.

Photometric Units and Quantities.—In the Digest August 11, an article of Prof. Blondel was abstracted suggesting a system of photometric units and in which the compiler drew attention to the objection to the French term "illumination" for the quantity which is equal to the product of what is in English, illumination by the factor time. "L'Ind. Elec.," Oct. 10, contains a letter from Prof. Blondel referring to this criticism, in which he suggests that the English speaking people change their word "illumination" to "enlightment," which he says corresponds exactly to the word "eclairement"; the term illumination has been adopted by an International Congress (of photographers) and it is therefore difficult to abandon it completely; but as the term is not free from objections it might be replaced by "lumination," which is a perfectly correct term and one which he thinks will be acceptable; the quantity represented by it is rarely used outside of photography and physiology and ought therefore not to cause confusion; but all confusion could be avoided if the English name is made "time-lumination," as suggested by the London "Electrician's" translation "time-illumination" (see Digest, Aug. 25). Regarding the other English terms he thinks those suggested in the Digest are correct translations and ought to be adopted without difficulty by English speaking electricians. In a table he gives the French, the English and German words and the international names of the units; the English are the same as those in the Digest, Aug. 11, except that for "intrinsic brightness" he prefers the term "intrinsic brilliancy;" (for the term "quantity of light," Mr. Hospitalier suggested "lighting," as stated in the Digest, Aug. 25); the German terms are the same as those given in the Digest, Sept. 22, with the word "strahlung" added for "intrinsic radiation. Regarding symbols, he thinks it best to wait until the definitions and units have found general acceptance. In the accompanying article by Mr. Hospitalier, he accepts the word "lumination" as satisfactory; in the next issue he promises a proposition for a system of symbols.

Photometry of Diffused Reflection.—A translation of a theoretical article by Mr. Lommel abstracted from the "Wied. Ann.," vol. 36, 1889, p. 473, is published in the Lond. "Elec.," Oct. 12. He states several propositions, one of which replaces Lambert's cosine law. Among others he states the two following propositions: "If an absolutely white body is illuminated by parallel rays from any direction, the amount of light sent out in all directions from its surface (its illuminating power) is proportional to the cosine of the angle of incidence. If the surface of an absolutely white body is equally illuminated from all directions, the quantity of light radiated by it in any given direction is proportional to the cosine of the angle of emergence." Observed results for paper and cardboard approach the new law more closely than the cosine law, but there is not even an approximate correspondence; for porcelain the divergences from the co-sine law amount to 31 per cent., but do not exceed 4 per cent. in the case of the new law.

Wire for Rheostats.—In the "Elek. Zeit.," Oct. 11, Mr. Strecker comments on a statement made by Messrs. Hertzog & Feldmann, in which they say that high resistance materials for rheostats for strong currents are not as suitable as copper or iron, proving the same theoretically, in which proof they show that the volume increases with the specific resistance of the material. He states that this formula, although it may be theoretically correct, is of no practical value; it is well-known that thick wires are not suitable for rheostats and that only small wires or bands are used, in which it may be said that the allowable current is directly proportional to the cross-section, which statement is not exactly correct, but it may be used for the comparison of different materials if it be understood that wires no larger than No. 20 to 14 B. & S. gauge are to be used; he discusses it theoretically and shows that the volume is nearly independent of the specific resistance and that the volume for high resistance materials will be somewhat smaller than that of good conductors; the chief advantage of high resistance materials is that a less length of wire is required, the less the higher the specific resistance; the construction of a rheostat will show that the chief cost is not the wire, but the supports, the cost of which will be greater for longer wires.

Duncan Meter.—The "Elek. Zeit.," Oct. 11, contains an editorial in which it is stated that this meter is not yet a solution of the problem of a really reliable meter, for two reasons; the speed of rotation is, as in all meters on this principle, dependent on the frequency, and the instrument must therefore be calibrated for every frequency; furthermore the instrument integrates the quantity of current, but not the power, and therefore if arc lamps or motors are in the circuit, which cause a shifting of the phase, the meter will register more than what corresponds to the real power consumed.

Theory of Wimshurst Machines.—The French Academy paper by Mr. Schaffers, mentioned in the Digest last week, is contained in full in "L'Ind. Elec.," Oct. 10.

Board of Trade Laboratory.—The conclusion of the article in the Lond. "Elec.," Oct. 12, contains a detailed description of the 100-volt multicellular voltmeter; also a description of the use of the instrument; a general plan of the laboratory is also given. In the continuation of the description in the Lond. "Elec. Rev.," Oct. 12, the engine and battery rooms, cable tank, testing-room and the machine-room are described, illustrations of the two latter being given.

Central Laboratory of Paris.—"L'Elec.," Oct. 6, publishes the rules governing this laboratory and the charges for tests and calibrations of various kinds.

DYNAMOS AND MOTORS.

Unipolar Machine.—An article by Mr. Ziegenberg is begun in the "Elek. Anz.," Oct. 7; in the issue of Oct. 11, he describes and illustrates a suggestion for a machine which has some interesting features; the field, with its coil, is made to rotate while the armature is at rest, by which device he avoids the sliding brushes on the outside edge of the armature which is at rest; the armature is in the form of a wheel with spokes which extend from the outside of the machine through the air-space toward the inside where the coil lies; the current is led off from the outside edge by fixed connections, while from the inside edge it is led off by brushes and wires leading to sliding contact rings on the outside of the machine; (how this disk is supported is not shown, but the intention is doubtless to support it from the outside); the illustration is merely diagrammatical.

Alternators in Parallel.—The subject is discussed in "L'Elec.," Sept. 29, in which a description of the Kapp system (see Digest, Sept. 29) is included.

TRANSFORMERS.

Transformers' Losses.—"L'Ind. Elec.," Oct. 10, abstracts briefly from a book by Mr. Feldman, the results of some observations made in a number of central stations. A 10-kw transformer is fully loaded for a mean of 440 hours per year, and if the losses are 2 per cent. in the iron and 2 per cent. in the copper, it requires 6,240-kw hours and the mean electrical efficiency for the year will be 70.5 per cent., with a maximum of 80.2 per cent in December, and a minimum of 55.4 per cent in May; if the losses are 3 per cent. in the iron and 2 per cent. in the copper the annual efficiency will be 61.8 per cent., with a maximum of 73.4 per cent., and a minimum of 45.5 per cent.; if the losses are 1.5 per cent. in the iron and 8 per cent. in the copper the annual efficiency will be 72.5 per cent., with a maximum of 79.9 per cent., and a minimum of 60 per cent.; from this it appears that the last proportions for the internal losses are the best.

Graphical Predetermination of Transformers and Multiphase Motors.—The "Elek. Zeit.," Oct. 11, contains at some length a mathematical article by Mr. Heyland, in which he describes the process in which the induction diagram is so constructed that on the basis of a constant potential the various results can be measured.

ARC AND INCANDESCENT LIGHTS.

Diminishing the Consumption of Arc Light Carbons.—The "Elek. Anz.," Oct. 7, describes a device by Mr. Jehl which consists essentially

of a bell shaped hood, opened downwards and covering the lower end of the upper carbon which slides through the top of the hood, the lower end of the carbon being on a level with the lower edge of the hood; this hood is carried on an insulated frame resting on the lower carbon by means of platinum wires which extend part way to the point of the carbon, thus allowing the whole apparatus to move down as the lower carbon is consumed; the action of this hood is to collect the gases which are produced and keep the point of the upper carbon surrounded by them, which reduces the consumption of this carbon quite materially. Tests made with a 6-ampere lamp without the apparatus showed a consumption of 14 mm. and 15.5 mm. of the upper and lower carbon respectively, while with the apparatus the consumption was 4.9 and 10 mm. respectively; a 9-ampere lamp which, without the apparatus, would burn 9.5 hours, burnt 25 hours with the apparatus. (Although not so stated, it appears that this apparatus is applied to existing lamps and replaces none of the mechanism of the lamp itself.

Cost of Electric Light.—A few comparative figures for electric light and gas are published in the Lond. "Elec. Eng.," Oct. 12.

ELECTRIC RAILWAYS.

Suspended Railway.—An editorial in the "Elek. Zeit.," Oct. 11, discusses the Langen system (see Digest, Oct. 13) in which the cars are suspended from an overhead track; the advantages claimed are: greater security; the possible use of a single rail or when two rails are used to bring them much closer together, thus increasing the facility of passing sharper curves; the height to which the passengers have to ascend is less than on overhead lines; that the cars will swing like a pendulum and relieve the supports of horizontal strain; that the construction is cheaper and simpler and that it does not cause a noise. The editorial calls attention to the fact that a similar system was suggested eight years ago and that another one was started in Ireland, but that since then the system has made no progress, from which it may be concluded that the theoretical advantages have not shown themselves to be such in practice; it is believed that the technical difficulties would be quite great; it is shown that there would be a horizontal stress and that it will involve difficulties to make the curves quite sharp, partly on account of the centrifugal force and partly because the wheels must be far enough apart to admit of placing the motor between them; it is believed that the danger of derailment in case of a single rail is greater than with two rails. A description of this system with comments, is also given in the "Elek. Echo," Oct. 13.

Canal Boat Propulsion.—"L'Ind. Elec.," Oct. 10, contains an illustrated description of an apparatus which has recently been tried; it consists of a propeller attached to the far end of the rudder and driven by an electric motor placed on the top of the vertical shaft of the rudder and driving the propeller by means of beveled gears running in a reservoir of oil; one of the advantages of this system is that it requires no change in the boat except the change of the rudder; the vertical pressure due to the weight of the armature is balanced by a magnetic system, which has the advantages of having no loss due to hysteresis (but which is not described); the weight of the whole rudder is balanced by making it hollow, so as to cause an upper pressure by displacement. It was tried on a boat 125 ft, long, of 180 tons, which attained a speed of 2.8 ft. per second, which is said to be 40 per cent. higher than that attained by two horses; the power consumed was 3.4 kilowatts; in certain favorable cases the speed was 3.3 ft. per second; the current was furnished by a battery of accumulators; the experiments were very successful, the chief advantage being the increased speed; even with accumulators the cost was less than that of animal traction; where traffic warrants it an overhead wire and trolley connection would be used; this will soon be carried out at Perrilly; it is thought that the water-power in the locks is generally much greater than that necessary for the traction.

Vienna Railway.—The concession for the underground railway across Vienna has been granted. Some statements regarding it are contained in the "Elek. Zeit," Oct. 11.

Electric Railways in the United States and Canada.—A reprint of Mr. Wilkinson's paper is begun in the Lond. "Elec.," Oct. 12.

Influence of Street Railway Circuits on Telephone Circuits.—See abstract under "Telegraphy, Telephony and Signals."

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Stage Light Regulator.—Mr. Mueller, in the "Elek. Zeit.," Oct. 11, describes the principle of a regulator for alternating currents. He states that regulation with choking coils cannot be used; his method consists in leading a number of branch wires from different parts of the secondary coil to step by step regulators; the short-circuiting of the windings between two branch connections is avoided by placing in each branch circuit a small choking coil; the number of the latter may be made half as great by connecting every other branch connection with the contact point on the rheostat and the intermediate ones with the next one above through small induction coils. The advantage of such a regulator over a wire resistance rheostat is to economise energy when the lamps are dimmed.

Berlin.—A brief but interesting summary regarding the foundation and growth of the single system, comprising five central stations in this city with a total capacity of 150,000 lamps of 16-cp, is published in the Lond. "Elec. Rev.," Oct. 12; as an average for the year 560 watts of current were obtained per kilogram (2.2 lbs.) of coal, a result which it is claimed has never before been reached in any central station in the world.

Worcester.—A well illustrated description of this combined water and steam power station, using high tension alternating currents, is published in the Lond. "Elec. Rev.," Oct. 12. The greater part of the issue of Oct. 12 of the Lond. "Elec. Eng." is devoted to a long and profusely illustrated description of this station.

Calais.—A brief illustrated description is given in "L'Ind. Elec.," Oct. 10; alternators are run with gas engines, but it is thought that the example will not be followed very often; a table of the results of some of the tests is given.

Governing Electric Light Engines.—The Lond. "Elec.," Oct. 12, reprints and discusses editorially an article from the London "Engineer."

WIRE, WIRING AND CONDUITS.

Oil Insulation for Feeders.—According to the Lond. "Elec.," Oct. 12, the high tension feeders for the installation at Worcester are to be laid according to the Brooks system (in which the wires are run through pipes containing oil); the system has proved itself to be very satisfactory at Chatham, Rochester and Keswick, and numerous other places where it has been in use for some years.

Long Trolley Wire–According to the "Elek. Anz.," Oct. 11, a German firm makes trolley wire in single lengths of a weight of 3,300 lbs.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Influence of Street Railway Circuits on Telephone Circuits.—The "Elek. Zeit.," Oct. 11, contains an interesting article by Dr. Wieslisbach, in which he discusses the subject and shows how the difficulties have been overcome in the city of Zurich. He states that experiments made on special circuits of 300 ft. are of no use; regarding the earth return currents he shows the great influence which the rail joints will have on the production of earth currents, if they are not very well made and even then the joints in time become bad; a single bad joint may give rise to injurious earth currents; this difficulty has been completely overcome in Switzerland, at least as far as telephone circuits are concerned, by laying an earth return wire of copper as large as the trolley wire, in the earth between the tracks and connecting it with the rails at points at most 300 ft. apart; the suggestion of Mr. Pearson to connect the positive instead of the negative pole with the trolley wire, would hardly be accepted by engineers as it involves a more rapid destruction of the trolley wire, and it would be much better to replace the trolley wheel more frequently than to renew the trolley wire. The effect of induction is not as easily guarded against; a parallel distance of 1,500 ft. with wires 30 ft. apart has been shown in Zurich to cause a noise in telephones which interferes with communication; it was found that even in metallic loop circuits the noise was only slightly less than on single circuits, but it was thought that in this case it was caused by a secondary induction from the single telephone lines and by making these metallic circuits no noises were heard; this was not the case, however, on the interurban lines of 100 miles and more, in which the noise was weaker in dry weather and louder in wet weather; a noise in these lines also induced a noise in the other lines on the same poles, and even if the good line was connected to a totally different line on which under ordinary circumstances there was no trouble; to avoid this the interurban lines were changed to another street, which overcame the difficulty completely. His conclusions are that a single line running parallel to a trolley circuit for more than 300 ft. cannot be used; metallic circuits can be used up to three miles under the conditions that all neighboring telephone circuits are metallic; long circuits are best transferred to another street; crossings cause no trouble if they are not too frequent, that is not more than three. Regarding the trouble caused by direct contact of the wires he shows that lightning arresters are not sufficient; to guard against a sudden current he recommends strips of tinfoil; to guard against a continuous current which would generate injurious heat in coils, the fuse would have to be so small that the slightest atmospheric discharge would rupture the circuit; to overcome this a double protection is used; the first consists of a tinfoil fuse which will melt at 4 to 5 amperes and the other is made of a fine German silver wire wound around a copper core which is soldered with an easily fusible alloy to some support; if a continuous current sufficient to heat this coil passes through the line, this alloy will melt and the copper core, which is held by a spring, then connects the circuit to earth which cuts out the apparatus, thereby decreasing the resistance and the consequent increase in current will then melt the fuse; the fuse is connected to the line side of the lightning plate and the German silver wire on the side toward the apparatus; with a single layer of German silver wire 0.1 mm. in diameter the apparatus will act with a continuous current of 0.1 ampere.

Underground Telephone Wires.—Dr. Weislisbach, in the "Elek. Zeit.," Oct. 11, states that when there are more than 100 wires it will be cheaper to lay them underground in a cable with paper insulation, than to run them overhead; the first cost is not appreciable higher, while the cost of maintenance is very much less, besides which speech is, as a rule, transmitted better.

Telephone in the Courts.—According to the "Elek. Zeit." Oct. 11,

three microphones have been placed in the Supreme Court of England with which lawyers and others may make connections to their offices, thus enabling them to listen to the proceedings without losing time in waiting for particular cases.

Progress in Telegraphy.—An abstract of the Board of Trade statistics is published in the Lond. Elec. Rev.," Oct. 12. Among other things it is stated that the first telegraph line was in Germany in 1833, the next in England in 1837 and the next in the United States in 1844, the last country adopting it being Spain, in which the first line was laid in 1885. The proportion between the number of messages per year and the population as a whole is now 1.8 message per head in the United Kingdom, 1.2 in Switzerland and 0.9 in the United States.

Speed of Submarine Telegraphy.—In a discussion of the subject in an editorial in the "Elek. Zeit.," Oct. 11, some figures are given on the line from Newcastle to Finland, in which the advantages of automatic transmission are shown. (Submarine.) A few figures concerning the Anglo-American Company's lines are given in "L'Elec.," Oct. 6, and "Elek. Zeit.," Oct . 11.

The 1894 Atlantic Cable.—The Lond. "Elec.," Oct. 12, contains an interesting descriptive article by Mr. Dearlove, giving tables of data and cross-sections of the various parts of the cable.

Pacific Cable.—The Lond. "Elec. Rev.," Oct. 12, contains an editorial on this subject; it concludes from the Ottawa conference that a good deal of preliminary work has yet to be done before the accomplishment of this great scheme is well within touch; it expresses disappointment at the results of this conference.

Telegraphy and Telephony in Cochin-China and Cambodia in 1893.—"L'Elec.," Oct. 6, gives a brief description.

ELECTRO-CHEMISTRY.

Chemical Theory of Accumulators.—The article by Mr. Wade is continued in the Lond. "Elec.," Oct. 12. He examines the only other remaining theory, the generally accepted one, of the direct formation of lead sulphate at both electrodes by the abstraction of two molecules of sulphuric acid, which are replaced by two molecules of water; the second molecule of sulphuric acid does not undergno electrical decomposition but is involved in a secondary reaction; the thermo-chemical equation for this case gives 1.855 volts, which although better than the others still leaves too large a discrepancy; it assumes, however, that the acid is diluted with a very large quantity of water. A curve is given, showing the results of Messrs. Gladstone & Hibbert and giving the observed voltage in all strengths of acid from 100 per cent. to zero; the two end portions of it are of little interest as they involve secondary and local reactions; to find how far this curve agrees with the calculated E. M. F. for various strengths of acid, he interpolates values between the two extreme cases of pure acid and very dilute acid by substituting successively the heat formation of the various proportions in the thermo chemical equation and obtains a curve which does not agree very well, giving in general, considerably lower values. He then shows that a reaction exists due to changes in the electrolyte which has heretofore been overlooked; "full allowance has been made for the energy required to separate two molecules of acid from the water with which it is diluted, but no account has been taken of the energy due to the further dilution of the remaining acid by this liberated water together with the two molecules of water which replace the acid which has been used up;" making this correction in the thermo chemical equation he obtains the value 2.0 volts; a corrected curve is given which practically coincides with that obtained by actual measurement between cells containing from 10 to 65 per cent. of acid corresponding to specific gravities from 1.070 to 1.570, which is a far wider range than is ever used in practice; he concludes that it may now be fairly claimed that the double sulphating theory of discharge does account for the E. M. F. strictly in accordance with Thomson's law, and from a thermo-chemical point of view therefore the case may be considered as proved. He draws some conclusions from this, showing the importance of considering the amount of acid and its distribution; he points out that a large excess of acid in a proportion from three to five times the necessary amount has been finally adopted; free access to the electrodes is very essential and within certain limits cells work more efficiently the farther the plates are apart, in spite of the loss due to internal rsistance; rapid diffusion and free supply are also necessary; he considers a hypothetical case from which he draws interesting conclusions, among which are that an insufficient supply of acid means a rapid fall of voltage and therefore a smaller output, but the efficiency is not affected; imperfect diffusion, however, means a loss of efficiency.

Accumulators.—In an article in "L'Elec.," Oct. 6, Mr. Leroy refers to the recent paper of Mr. Darrius (see Digest, Sept. 15, 22) in which it was shown that the efficiency was less than when the accumulators were connected in parallel, owing to local connections between the various cells; Mr. Leroy suggests that what is true of different cells in parallel may be true also of the plates in the same cell, resulting in a partial discharge between the plates themselves; he suggests that the experiment might be tried to discharge the separate plates first together in one cell and then in pairs in different cells; he concludes that for this reason the smallest number of plates possible should be used and that the connections between them should be made as well as possible, soldered instead of clamped, and that it is bad practice to introduce a new plate in the place of an injured one. He believes that it would be better instead of connecting all the plates of one cell together, to use the less common system of connectng each plate with a corresponding opposite plate in the next cell, using what is known as twin plates; this could readily be determined by experiment if such a series of cells was discharged and then again discharged with the plates all connected together.

Plating Aluminium.—A method devised by Mr. Goettig, and which has been commented upon very favorably by the Neuhausen Aluminium Company, is described briefly in the "Elek. Anz.," Oct. 11. If the aluminium is to be copper-plated it is rubbed with tin-foil, moistened with a nearly concentrated solution of copper sulphate; the principle of the method is that if certain metals whose solutions are not decomposed by aluminium, are rubbed on to the aluminium, an adherent coating of the metal will be produced if the material with which it is rubbed makes a galvanic cell with the aluminium and the solution such that the aluminium forms the cathode.

Electrolytic Preparation of Manganese.—The Voltmer method is briefly described in the "Elek. Anz.," Oct. 11.

Hermite Process—The Lond. "Elec.," Oct. 12, states that it has been decided to adopt this process at Ipswich; the decision was based on the exceedingly favorable report of the trials which have been made on the main sewers of the town during the past three months.

MISCELLANEOUS.

Coal Cutting.—In Mr. Snell's serial in the Lond. "Elec.," Oct. 12 some electrical coal cutting machines are described and illustrated.

Furnace—A description of the Moissan furnace, and his method of making diamonds and other products, is given in the "Elek. Anz.," Oct. 11; diamonds as large as 0.5 mm. in diameter have now been produced.

Destruction of a Cable by Lightning.—According to the "Elek. Anz,." Oct. 7, the cable in the Gothard tunnel was recently destroyed by lightning; this curious case is supposed to have been due to the fact that the lightning entered an overhead line at one end and found an easier path to earth at a lightning arrester at the other end.

Electric Ignition in Gas Engines.—"L'Ind. Elec.," Oct. 10, contains an article by Mr. Armagnat, in which he discusses at some length the various methods for electrically igniting the gas in gas engines and points out the defects and their remedies. Among other things he shows that the connections usually adopted by having a common wire for connecting the frame of the engine with both the primary and secondary of an induction coil, is not the best, and that often much better results would be obtained if there was no connection between the two coils; also that with a reversal of the connections of the two poles of one of the coils, when a common return wire is used, the spark may become greater or less, and that therefore a simple reversion of the connections may sometimes improve the spark considerably.

Water Level Indicator.—A device for indicating the water level at a distant point, is described and illustrated in the "Elek. Echo.," Oct. 13.

Electro-Therapeutics.—The Lond. "Elec. Eng.," Oct. 12, abstracts briefly an article from the "Lancet," describing some satisfactory applications of static electricity in the healing of certain skin diseases and ulcers, by Prof. Doumer of Lille.

Treatment in Case of Accident.—London "Lightning," Oct. 11, publishes a table of instructions adopted by the telegraph department of the Midland Railway, containing also instructions regarding the treatment in case of serious accident.

New Book.

ELECTRO-MAGNETIC THEORY. Vol. 1. By Oliver Heaviside. London: "The Electrician" Printing and Publishing Company, Limited. xxii + 466 pages. Price, $5.00.

Mr. Heaviside is a man of genius, and his writings are always of great value and very interesting, even when we cannot agree with his conclusions. So independent and original is Mr. Heaviside's mode of thought that he grows impatient of what he considers the restraints of accepted methods, and becomes iconoclastic. Even the English language is not large enough for his expansive ideas without extensive additions, and accordingly he proceeds to coin a quantity of grotesque words, which frighten the timid reader, and send cold shivers down the back of the philologian. In this connection we would like to know why, after forcing the word "inductance" down the throats of the electrical profession as the only proper companion for resistance, the author should use the discredited "self induction" throughout the book.

Another reform advocated by Mr. Heaviside is the practical abolition of Euclid. On page 148 he says "Euclid for children is barbarous," and advocates the substitution of vector geometry. Right here we wonder whether vectors will do all that is done by Euclid, and turning back to page 143, where the author is explaining his vector algebra, we find that he appeals to that musty old barbarian, "Euclid I., 47," as authority for $r^2 = x^2 + y^2 + z^2$. It was not then altogether in vain that Pythagoras barbecued an ox in honor of the discovery of this theorem, if after two thousand years an Oliver Heaviside quotes it from Euclid instead of proving it by vectors.

Personally we do not agree with Mr. Heaviside about Euclid; we still cling to the old fogy notion that the study is a valuable discipline to the youthful mind, even when the theorems are never put to any use. Even the great Newton, who at first held Euclid in contempt, later revised his opinion and studied him carefully. We think the fact that Euclid has lasted two milleniums is not altogther due to vicious conservatism, but in part at least to the intrinsic merit of the book. Even if Mr. Heaviside has produced as good a vector geometry as he thinks he has, it by no means follows that Euclid either will or ought to pass into oblivion. After centuries of the printing press, and decades of the typewriting machine, we still have some use for handwriting; after half a century of the mowing machine we still use the scythe, and after two or three generations of the steamboat there are some sailing craft still left, to say nothing of rowboats.

It is this sanguine spirit of reform that leads Mr. Heaviside to look lightly upon all obstacles. The reform nearest his heart is the suppression of 4π where it does not belong and its introduction where it does belong according to his ideas. We admit at once that there is a great deal to be said on his side of the argument, and it may not be as difficult to make the change as most of us have supposed. By a strange coincidence Mr. J. T. Sprague is on the same side of the question as Mr. Heaviside.

In Mr. Heaviside's system the electrostatic unit of quantity of electricity is not, as with the present system, that quantity which repels an equal quantity at unit distance with unit force, but the force $= \frac{1}{4\pi}$ and the same applies to unit magnetic pole. In the present system the electrostatic capacity of a sphere of unit radius, is unity, and when charged with unit E. M. F. the surface density is $\frac{1}{4\pi}$ and the total flux of force is 4π. In Mr. Heaviside's system the capacity is 4π and the charge at unit E. M. F. is of course 4π the surface density unity and the total flux of force being as in the present system, 4π.

Admitting for the sake of argument that the advantages of Mr. Heaviside's system are as great, and the difficulties of making the change as small, as he says they are, we still have no guarantee that his system will be final. In the first place, there are sensible persons who do not approve of the metric system except in the one particular of the decimal relation of units so far as it is carried out. But granting the metre to be the ideal unit of length, and not to require any future alteration, there is a second fact worth considering.

There is a prevalent belief that the relation of physical quantities is such that it is necessary and sufficient to arbitrarily fix the magnitudes of three units (which are assumed fundamental), in order to derive the magnitude of the other units. This belief is probably partly due to the fact that Maxwell uses three arbitrary units—length, time and mass. This, however, was in deference to the British Association, which had already adopted the C. G. S. system. Those who will read Maxwell's chapter on units carefully will see that he there shows that only two arbitrary units are necessary, in order to derive all the others.

If we take as a unit of mass that quantity of matter which will attract an equal quantity of matter at unit distance with unit force, we make the unit of mass a derived unit. But we have apparently here assumed unit force an arbitrary unit; this, however, is only apparent. For if we consider the acceleration produced by the given mass on a second mass, we see that it is independent of the magnitude of the second mass. That is, if the second mass be increased to n times the attraction will be increased n times, and so the acceleration which the attraction will produce in unit time (if the attraction be kept constant while the second mass moves), is constant. We may therefore assume the second mass equal to the first and then the attraction by the definition of unit force now used in the C. G. S. system will be unity. In this system the dimensions of mass, are $T = [L^3 M^{-2}]$. It would doubtless be a more scientific system than the present system, but would not suit Mr. Heaviside unless we make the attraction between units masses $\frac{1}{4\pi}$

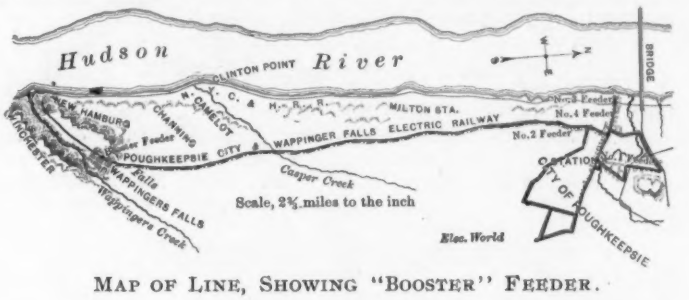
We have made this apparent digression to lead up to a very pertinent question. Is the whole scheme of units to be changed every time that anyone discovers that it would be possible to construct a more scientific one? If so, the one thing we can depend upon is that it will be a long time before we reach the final system, if indeed we ever reach it. Perhaps electricians will become so used to "positively last and final revisions" that they will not care how much or often the units are changed.

Space does not allow us to even mention all the original departures in this work, and we must leave them for the reader to find himself. While we do not by any means concur in all the author's opinions, we think that he has made many valuable contributions to science.

A Model Electric Railway.

The electric railway between Poughkeepsie and Wappinger's Falls, New York, lately completed, is an example of good engineering work and comprises, among other features, an application of the "booster" system of feeding. The entire engineering supervision of the work has been under the charge of Mr. J. H. Vail, chief engineer of the Electrical and Mechanical Engineering and Trading Company, 39 Cortlandt street, New York, from whose offices all plans and specifications were issued.

The boiler-room contains two 300-hp Sterling boilers, and is of capacity sufficient for a duplicate battery. It is floored with brick, laid in cement and grouted. In the engine-room are two 200-kw General Electric multipolar generators, each of which is direct connected to a 300-hp Ball & Wood compound condensing engine. The foundations for these units are of extremely heavy masonry. As in the boiler-room, there is here space for duplicating the plant. The condenser, feed water heater and boiler feed pumps are located in the rear of the engines and close to the division wall. All of the piping is carried in pipe channels below the floor line, the floor being composed of twelve inches of concrete surfaced with an inch of Portland cement. The pipe channels are provided with cast iron covers, set flush with the flooring, this arrangement affording easy and convenient access to any part of the piping system. The switchboard is built up of black enamelled slate

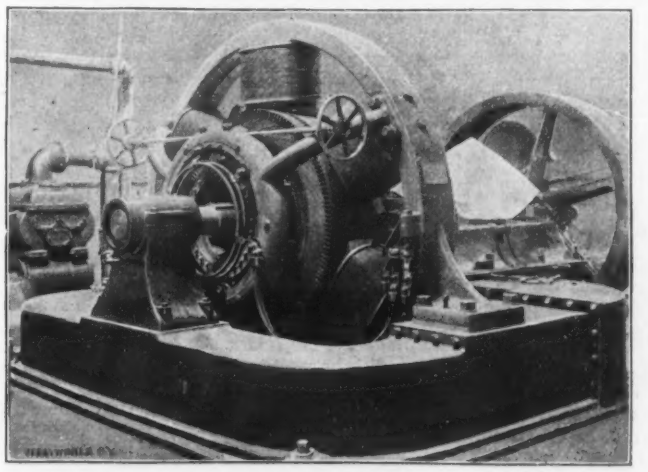


MAP OF LINE, SHOWING "BOOSTER" FEEDER.

slabs and is of the General Electric panel type. The dynamo leads run beneath the floor in vitrified pipe conduits. The track system consists of 10 miles of single and double track, laid through the streets of the city. A spur 10 miles in length reaches from Poughkeepsie along the Ridge Road to Wappinger's Falls and thence to New Hamburg. The heaviest grades within the city limits occur on that portion of the line leading from the steamboat landing on the Hudson River, near the New York Central Depot, up Main street, for about one mile. The grades here vary from 5 to 8½ per cent. The track on Main street is laid with 90-lb. girder rails, furnished by the Johnson Company. The remainder of the track is laid with 60-lb. and 56-lb. T rails. The track is bonded throughout with two No. 0, B. & S. copper wires, riveted in place, all of the electric bonding being performed by the employees of the railway company, under the direction of the Superintendent.

The line leading from Poughkeepsie to Wappinger's Falls is nearly straight in its course, the grades varying from 1 to 8 per cent. Between Wappinger's Falls and New Hamburg, where the track leads down toward the Hudson river, the grade is as heavy as 9 per cent.

The line construction consists of the usual form of stout octagonal hard pine poles with treated butts. These are set up on Main street and



ONE OF THE GENERATING UNITS.

Market street, the remainder of the poles throughout being round, shaved and painted.

Spanwire construction is used throughout the city; bracket construction is used on the line leading to Wappinger's Falls and New Hamburg. The trolley wire is No. 0, B. & S., supported by 5-16 inch stranded steel span wire. The line material is of the H. W. Johns' manufacture.

Feeders of No. 4=0, B. &. S. wire are placed as required for electric distribution within the city limits. An interesting feature of the feeding system is the application of the booster idea to the long distance feeder from the power-house to Wappinger's Falls. The feeding point is eight miles from the station with a 9 per cent. grade, two miles beyond the end of the feeder. By the use of the booster it is possible to properly supply this section of the line through two No. 4=0, B. & S. wires. The Woodbridge & Turner Engineering Co. constructed the line work,

while the track construction, including bonding, was under the charge of Supt. C. M. Davis of the Railway Company.

The rolling stock equipment consists of eight closed motor cars, 18 feet in length, built by James A. Trimble of New York; ten open motor cars, 30 feet in length, built by the American Car Co., of St. Louis, Mo.; and two closed vestibuled cars, made by the latter company. All motor cars are mounted on the latest type of Peckham cantilever truck. The electric equipment of the cars consists of two G. E.-800 motors per car, with type K series-multiple controller. All cars are fitted with the Star electric headlights, and all closed cars with the American Car Heating Company's electric heaters.

The new electric railway will supplant an extensive passenger and express stage business between Poughkeepsie and Wappinger's Falls. It furnishes convenient transportation facilities between the river front and the higher urban localities, such as Vassar College, the Seminary, the Driving Park, the Insane Asylum, the P. & E. R. R. Depot, and the Cemetery. The same accommodations are offered at the New Hamburg end of the line, which reaches down to the river front.

Combination Fixture for Public Halls.

Since the recent fire, Saenger Hall, Newark, N. J., owned by Judge Krueger, has been enlarged and handsomely re-decorated and re-furnished, and the most prominent feature of the decorations are three prismatic combination fixtures, made by I. P. Frink, 551 Pearl street,

Prismatic Combination Fixture.

New York. Each contains fifty gas burners, and fifty electric lamps, which light the hall so brilliantly as to have excited unusually favorable comment. Through the courtesy of the manufacturers we print herewith an illustration of one of the fixtures, which is known as the suspended, double-cone, prismatic sunlight type.

A New Motor.

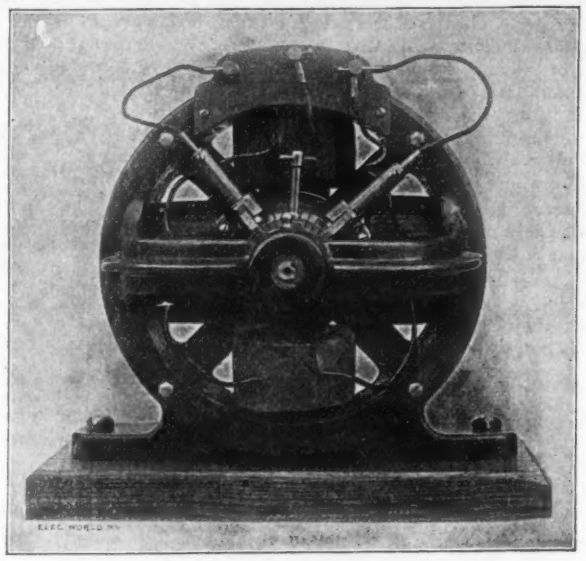
A new motor manufactured by the Elliott-Lincoln Co., Cleveland, O., is of the four-poled type, and is supplied with four field coils, making all four poles direct. The field coils are wound on forms and slipped over the poles. The iron in the field is so arranged, that there is the same cross section for the magnetic lines at all points of the magnetic circuit. The frame with the poles pieces and support for the pulley end are all cast in one piece, while the support for the commutator end is cast to a ring, which is bolted to the frame. This construction makes the bearings very rigid and stiff.

The brush holders are attached to the casting, which supports the commutator end of the armature, and have an indefinite range of adjustment. Arc light carbon pencils are used for brushes. These brushes give excellent service, and have the incidental advantage of being easily replaced. The bearings are supplied with a wick oiling device in the smaller sizes, and with a ring and self-centering bearing in the larger sizes. The speed is very low, that of the one-half-hp machine being 1,300 revolutions per minute.

A New Water Tube Boiler.

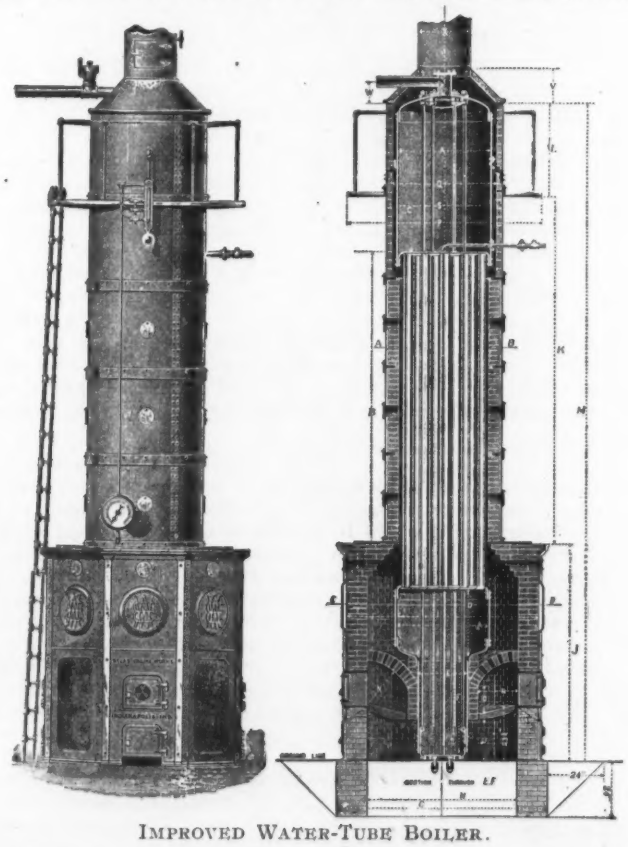
A new type of vertical high pressure water tube safety boiler, which we illustrate herewith, is being placed on the market by the Atlas Engine Works, Indianapolis, Ind., and possesses some interesting features.

The boiler is mounted in an upright position within an enclosing casing lined with fire brick. The lower part is a peculiarly shaped



Elliott-Lincoln Motor.

drum of an inverted bottle form, a central portion of less diameter extending down below the grate, while the main portion is held at a considerable height above the fire. The contracted portion of the lower drum is encased by fire brick. The mid-height of the boiler is a set of vertical tubes. The upper part is a drum in which a liberal surface is presented for the disengagement of the steam from the water. The descent of the water through the central tubes is promoted by a set of telescoping tubes extending the water tubes to near the bottom of the water leg, and which may be slipped up into the water tubes out of the way whenever necessary to enter the water leg for cleaning or repairs. When extended downward so as to be fully efficient, they protect the



Improved Water-Tube Boiler.

central set of tubes from being affected by the large volume of steam generated in the exterior portion of the lower drum. The steam generated there rises through the series of tubes above, thus insuring an active upward current of steam and water, and further steam is generated by the circulation of the gaseous products of combustion through the spaces between the tubes. The steam and water thus rising separate

in the upper drum and the steam is conveyed away for use. The water descends through the central tubes of the series, which tubes are over the central portion of the bottom. The small quantity of steam generated in these central tubes is carried down by the descending current, and, moving outward in the lower portion, rises and adds to the velocity of the strong rising columns in the tubes near the periphery of the series.

The non-conducting protection between the central portion of the boiler and the annular furnace which surrounds it, protects the fire from tbeing too much cooled along the inner edge, and allows all portions of he grate surface to be about equally efficient. The fire-brick also preserves that portion of the boiler from being overheated in any exigency.

The annular grate is slightly inclined inward. The annular furnace is fed, cleaned, etc., through doors in the outer casing. A perforated protection of fire brick is extended over the fire at a proper height. At the mid-height of the tubes the masonry wall is extended inward so that it comes nearly or quite in contact with the outermost tubes. The hot gaseous products of combustion deflected inward thereby, are caused to circulate among the tubes. They are afterwards led outward and upward around the exterior of the upper drum and finally collected and conveyed away through a central stack at the top.

New Double Discharge Turbine.

The accompanying illustration represents a new type of turbine wheel, built by James Leffel & Company, Springfield, O., which is simple in form and capable of easy and substantial construction; the wheel shown drives a portion of a large electric plant where several others of the same design and style are in use, under a working head pressure of 90 feet.

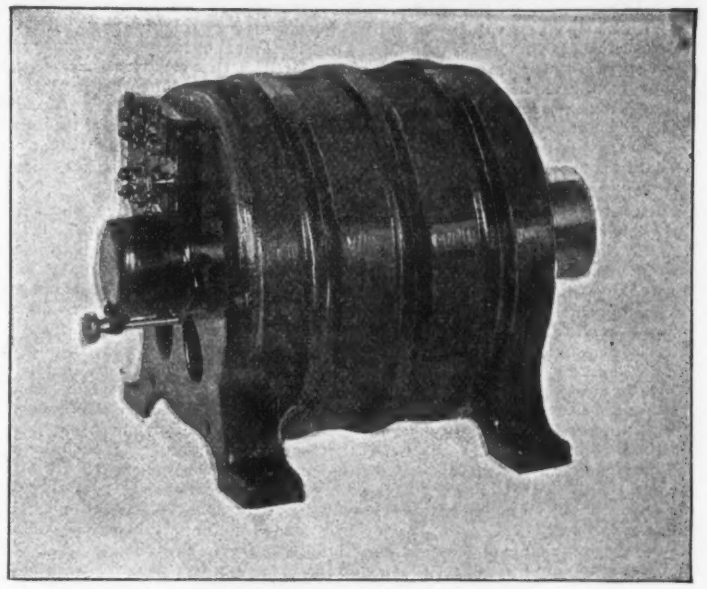
It will be seen that the water enters vertically on the top. The design, however, admits of receiving the water at any inclination from a vertical to a horizontal line. When it enters the outward casing, in which is placed the guide casing of the wheel or runner, the water completely surrounds the latter, under whatever head pressure the wheel is placed, and is admitted to the circumference of the runner or wheel proper through the guides, leaving the wheel after doing its work.

The runner itself is a double wheel, receiving the water from a single set of guides, which surround the circumference of the runner. The wheel is so constructed as to divide the water into two equal portions and discharge it horizontally in opposite directions, on the performance of its work, passing through the curved tubes on each side of the wheel and discharging into the tail water below. This method of application of water to a turbine entirely avoids end thrusts or end pressure of the shaft; in other words it prevents the water from getting between the wheel and any part of the casing, thus avoiding loss of power by relieving the wheel from excessive friction. The wheel illustrated is 30 inches in diameter and of 550-hp capacity. Its regulation is nicely secured automatically, by means of a special governor shown in the cut, thus rendering the wheel highly efficient as a motor for electric light, electric power and various purposes, for which a large number is now in use.

The wheel illustrated has a pulley of 42 inches face and 48 inches diameter, transmitting the whole power through a 40-inch belt to the electrical machinery. The design is essentially the same as that of the two turbines of 1,200-hp, each built for the Cliff Company at Niagara Falls, except that with the latter neither pulleys nor governors are used, the power being applied directly to the machinery at each end of the water-wheel shaft on each side of the turbine.

Small Induction Motors.

A good example of the smaller line of induction motors which the General Electric Company is placing on the market is that known as the T. I. one-hp, which we illustrate. This motor has been designed to give a powerful starting effort without excessive current. It is almost completely enclosed and may be entirely so if desired. It is totally without moving contacts and the only connection it has with the external circuit is through the binding posts on the outside of the motor. The armature has no connection with the external circuit. Inside of the

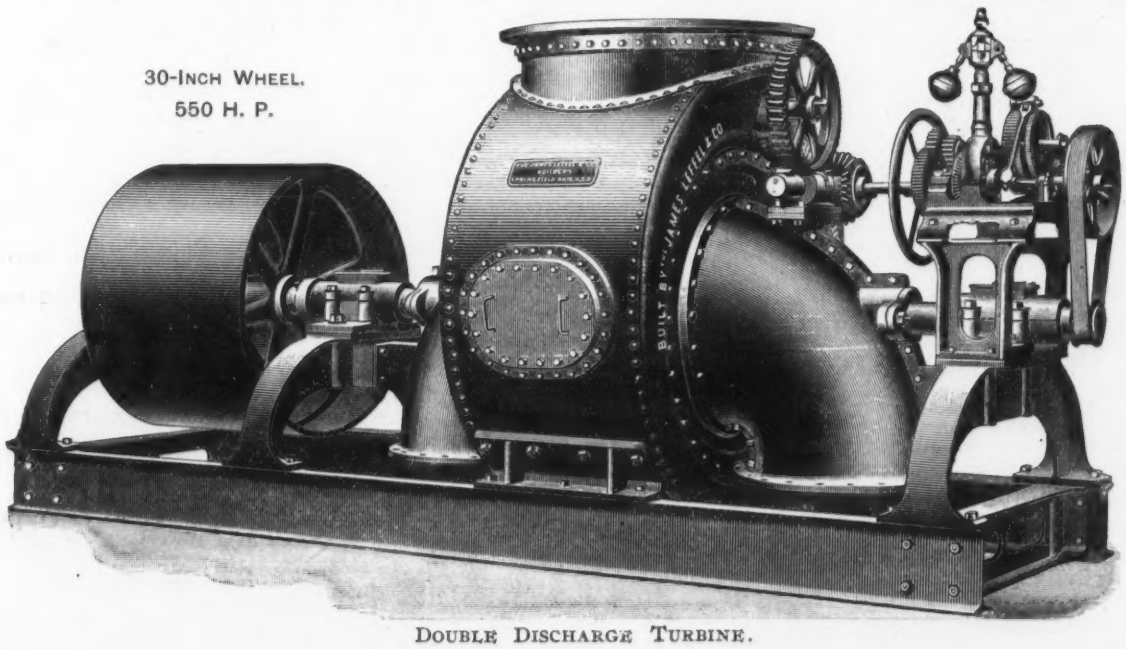


SMALL INDUCTION MOTOR.

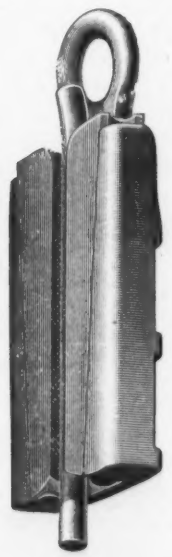
armature is placed a resistance, only kept in circuit when the motor is first started. The plug shown under the bearing short-circuits this resistance as soon as the armature has attained its speed. The motor is wound for 110 volts, and owing to the simplicity of the winding and the low potential, burn-outs are almost impossible. The absence of commutator and collector rings obviates all danger of sparking and entails the minimum amount of attention in operation. As regards efficiency, uniformity of speed and output per pound of weight, this motor is equal to the best continuous current motors of similar output.

The Cope Come-Along.

The come-along shown in the accompanying illustration, and made by the Hubley Manufacturing Company, Lancaster, Pa., contains several improvements over the usual form of this useful tool. The jaws are slightly curved on their bearing surface instead of being straight, and have a checked grooving instead of the ordinary filed grooving. These improvements ensure a much firmer grip of a wire and thus render it less liable to injury from slipping in the jaws.



DOUBLE DISCHARGE TURBINE.



COME-ALONG.

Financial Intelligence.

The Electrical Stock Market.

New York, Oct. 27, 1894.

THE ELECTRICAL STOCK MARKET has not kept up either in point of activity or strength to the record of the past few weeks. With the exception of one or two stocks that always will remain speculative favorites by reason of the ease with which their values—or rather quotations—are manipulated, the electric stock list has this week been devoid of stock market interest. It must not be supposed, however, from the lack of transactions, that electrical stocks have lost favor; in their inactivity they are only acting in accordance with the apathy marking the whole Stock Exchange list. The bottom seems really to have dropped out of the stock market. Despite the plethora of money, the investing and speculative public holds totally aloof from stocks; what little there is doing is for the account of eights and quarters scalping professional traders.

GENERAL ELECTRIC alone serves to redeem the electrical stock list from utter lifelessness. In fact, it has been one of the few active spots in the whole stock market, but, as last week, the activity has all been on the bear side, and the stock closes for the week at a considerable loss in quotation. The officials of the company continue to profess their inability to understand the weakness in General Electrics. They aver that no change has come in the good business conditions on which General Electric has held so firm all along, and they insist that a proper appreciation of its present profit-making condition would result in sending General Electric's quotation up instead of down. All the same, the friends of the property fail to back up their spoken belief in its future by giving any support to the stock. Of course, this may not mean that they have less confidence than they talk about, but, when it is remembered that in former times bull talk was always substantiated by big inside purchases, the present indisposition of General Electric's to follow up their talk of big earnings with buying of the stock, is not regarded with much favor. But times and conditions in General Electric have materially changed, and the present course of the management and its friends may be commendable instead of disquieting. As it is, the bears continue to circulate uncontradicted all species of tales reflecting on the company, and, whatever may be their truth, they have surely had the effect of frightening out some long stock. For instance, the bears have put into private circulation a statement showing that there are only $9,000,000 in assets to represent the value of $30,000,000 common stock. No official criticism of these figures has been made public, and the statement has found a lot of believers. Another explanation of the selling of long stock, as given by the Wall Street Journal, is to the effect that the decline in General Electric from 35 was precipitated by the decision of a Boston bank to sell 2,200 shares of the stock which it had had in a loan from 75. Becoming tired, the bank had closed the loan, giving the order to sell the stock to one of the most prominent bear houses in this city. This induced considerable short selling, to an extent that resulted in more long stock coming out.

WESTINGHOUSE ELECTRIC does well to hold its own in this week of declining quotations. Friends of the property continue to extol its prospects once it is in possession of the new plant where it will have everything in the way of improved machinery and methods for manufacturing supplies and apparatus known to the electrical trade. With its low capitalization of about $10,000,000, of which one-half is common stock and less than $1,000,000 in bonds, thus making fixed charges, including preferred stock dividends, very little, not more than $400,000 a year, and with its most economical methods of producing electric apparatus, the hopes of the management regarding future profits seem well founded.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	101½	102½
" " " Brooklyn	100	109	110
" " " Boston	100	128	130
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	34⅛	34¼
General Electric pref	100	65	70
Interior Conduit & Ins. Co.	100	25	35
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35½	36
* " " pref	50	52¾	53

BONDS.

*Edison Electric Ill., New York	1,000	107⅝	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	88	90

TELEGRAPH AND TELEPHONE.

*American Bell Telephone	100	198	199
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
*Central & South American Telegraph	100	101½	105
*Commercial Cables	100	125	145
Erie Telephone	100	51¾	52¼
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
New England Telephone	100	67	69
Postal Telegraph-Cable	100	54	60
*Western Union Telegraph	100	87⅛	87½

* Ex-div.

AMERICAN BELL TELEPHONE matters are momentarily very quiet, but there is a likelihood that at an early date events are likely to occur that will have an important bearing on the company's future and on the stock's immediate value. There is a disposition to call a special meeting of stockholders within a few weeks to take action on recent legislative matters. It may be tha Stockholders will authorize the sale at auction of $1,000,000 (10,000 shares) of new stock for the sake of experiment. If it is a failure the decision of certain large interests that it is the best for the company to move out of Massachusetts will be materially strengthened. An official says that the "development of the company and its service to the public would be far ahead of what it is to-day had it not been for the restrictions placed upon the company through legislation."

THE ERIE TELEGRAPH AND TELEPHONE interests, since the stock was listed on the New York Stock Exchange, continue to try to excite an artificial interest in the stock by retailing from day to day facts concerning the company's operations and condition. This week's contribution relates that the company has over 6,000 miles of underground wire and that it is steadily extending its metallic circuit system. Treasurer Glidden says that the company's business has made a very material improvement during the past two months. Excepting one or two wash sales, nothing at all has been doing in the stock to mark a result of these endeavors.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES trustees continue to lay aside money wherewith to buy preferred stock. They will receive bids until Oct. 29 for as many shares as $50,000 will purchase.

WESTERN UNION TELEGRAPH stock moves very little either way. In the present dull stock market its fluctations are absolutely without significance.

THE UNITED ELECTRIC SECURITIES COMPANY is also in the market to buy its own bonds; it wants proposals for the sale to the company of as many of its collateral trust 5 per cent. seventh series bonds as can be purchased with $21,000.

New Incorporations.

THE PACIFIC ELECTRICAL COMPANY, San Francisco, Cal., capital stock $30,000, has been incorporated.

THE LONDON ELECTRIC COMPANY, London, Ontario, capital stock $250,000, has been incorporated.

THE JENNEY ELECTRIC CONDUIT COMPANY, Chicago, Ill., capital stock $5,000,000, has been incorporated.

THE WADSWORTH GENERAL ELECTRIC COMPANY, Wadsforth, O., capital stock $10,000, has been incorporated by J. A. Clark and others.

THE PETER ELECTRIC CONDUIT RAILWAY CONSTRUCTION COMPANY, Milwaukee, Wis., has been incorporated with a capital stock of $500,000.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., capital stock $20,000, has been incorporated to manufacture electrical and mechanical specialties.

THE NOKOMIS ELECTRIC LIGHT AND POWER COMPANY, Nokomis, Ill., capital stock $10,000, has been incorporated by George Bliss and others.

THE CITIZENS' GAS AND ELECTRIC POWER COMPANY, Lafayette, Ind., has been incorporated by P. C. Somerville, A. O. Behm and Laban Spraks.

THE PACIFIC ELECTRIC COMPANY, Pacific, Mo., capital stock $5,020, has been incorporated to operate light and power plants. A. H. Brown, A. Kappitz and G. H. Gross, Pacific, Mo., are the interested parties.

THE ECLIPSE ELECTRICAL COMPANY, St. Louis, Mo., capital stock $9,000, has been formed to manufacture electrical appliances. Charles F. Smith, Isidor Fagans and E. C. H. Foelkers, all of St. Louis, are the organizers.

THE TERRE HAUTE AND BRAZIL ELECTRIC RAILWAY COMPANY-Terre Haute, Ind., capital stock $16,000, has been formed to operate an electric railway. Max Joseph, C. F. Miller and J. G. Elder, Terre Haute, are the incorporators.

THE MAGNETIC TELEPHONE COMPANY, Oak Park, Ill., capital stock $100,000, has been formed to manufacture and sell telephones, electrical appliances and machinery. Henry E. Procuiner, George W. Wilson and David J. Kennedy are interested.

THE POLAR STAR ELECTRIC COMPANY, Faribault, Minn., capital stock $50,000, has been formed to manufacture and supply electricity for light, heat and power. Jas. Hunter, Robt. G. Weatherstone, and Jas. F. Hughes, Faribault, Minn., are the promoters.

THE KANSAS CITY TRACTION COMPANY, Kansas City, Kan., capital stock $1,000,000, has been incorporated by S. Bird Colen, Brooklyn; W. J. Smith and W. H. Lucas, Kansas City, Mo.; A. W. Trickett, Frank D. Hutchins and C. F. Hutchins, Kansas City, Mo.

THE CHICAGO CENTRAL ELECTRIC RAILROAD COMPANY, Chicago, Ill., capital stock $1,200,000, has been formed to construct and operate by steam or electric power railroads and tramways. Geo. W. Waterman, Wm. R. Odell and Chas. A. Boos, are the promoters.

THE MUTUAL GAS ELECTRIC COMPANY, Brooklyn, N Y., capital stock $100,000, has been formed to manufacture and supply gas and electricity. A. W. Wannaker, Jersey City, N. J.; Thomas Patterson, Brooklyn, and Chas. H. Selig, New York, are the organizers.

THE MARKS-AYER ELECTRIC COMPANY, Plainfield, N. J., capital stock $350,000, has been formed to generate and sell electricity for light, heat and power, etc. Louis J. Marks, New York, James I. Ayer and Harry G. Runkle, of Philadelphia, Pa., are the promoters.

THE COMONWEALTH ELECTRIC CONSTRUCTION COMPANY, Camden, N. J., capital stock $100,000, has been formed to construct and manufacture dynamos, motors, lamps, etc. L. B. Henry, Eddington; Robt. H. Crozer, Upland and W. Hartel, Philadelphia, Pa., are interested.

THE OHIO ELECTRIC GAS COMPANY, Springfield, Ill., capital stock $250,000, has been formed to manufacture and sell machinery for the purpose of generating gas for illuminating and heating purposes, etc. H. Clay Wilson, Jno. G. Freidmeyer and Benj. Knudson are interested.

THE GOLD BLOSSOM GOLD MINING COMPANY, San Francisco, Cal., capital stock $20,000, has been incorporated to deal in and operate mines, machinery, etc., and also electric light and power plants. Charles F. Reed, Auburn, F. A. Berlin, and Emile Basson, San Francisco, Cal, are the organizers.

THE UNITED STATES TELEPHONE COMPANY, Chicago, Ill., capital stock $75,000, has been formed to construct, operate and maintain telephone and telegraph exchanges; trunk lines for electrical telephone and telegraph purposes; also to manufacture and deal in electrical supplies of all kinds that pertain to its business. Henry S. Perkins, Elias C. Greenlee and Nelson G. Franklin are the incorporators.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Oct. 29, 1894.

THE R. THOMAS & SONS COMPANY, East Liverpool, Ohio, have opened an eastern office at 39 Cortlandt street, which has been placed in charge of Mr. J. E. Way, who formerly looked after the company's extensive supply business in Chicago.

THE ELECTRICAL & MECHANICAL ENGINEERING COMPANY, 44 Broad street, has closed a contract with the Brooklyn Bridge Trustees for lighting the bridge cars by electricity and furnishing the entire steam and generating plant and distributing system.

MAYOR SCHIEREN, of Brooklyn, has received a petition signed by numerous citizens asking to light the Boulevard from Prospect Park to Coney Island. Major Peter H. McNulty, of Parkville, Supervisor W. B. Bennett, of the Thirty-first Ward, and Mr. James Burrell, of No. 11 Clinton street, Brooklyn, are the prime movers in the project.

MAXWELL M. MEYER, late electrician and superintendent of the Zucker-Levett Chemical Company, Grand street, New York, is about to embark in the manufacturing of dynamos and motors for light and power work. The factory will be at 411 East 107th street, New York, and the business office in the Electrical Exchange. Mr. Meyer is a young man but old in experience, which will no doubt enable him to be a successful competitor in his line.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, October 27, 1894.

MR. H. HUBBELL, manufacturer of machinery and tools, 675 State street, Bridgeport, Conn., reports business as exceedingly good. His specialties are the manufacture of automatic tools, tapping machines and brass machine screws for electrical purposes.

MR. F. W. DAVIS, secretary of the Perkins Electric Switch & Manufacturing Company, of Hartford, Conn., has just started on a Western trip, covering Chicago and all principal Western cities and returning by way of Montreal and other Canadian centers.

MR. NELSON W. TWISS, 28 Whitney avenue, New Haven, Conn., manufaturer of the "Twiss" improved automatic cut-off engine, reports improved business. The "Twiss" engine is especially adapted for isolated plants, and has already received recognition in this direction.

MR. EDRED W. CLARK, 31 Welles street, Hartford, Conn., manufacturer of machinery, and particularly of rubber moulds and rubber machinery, has received some good orders lately for his improved tubing machine for the covering of electrical and telephone cables, which it is claimed has no superior and which is quite generally used by wire and rubber companies.

THE NATIONAL PIPE BENDING COMPANY, of New Haven, Conn., which manufactures the National Feed Water Heater, so well and favorably known generally, not only in this country, but abroad as well, is constructing a new building adjoining its plant, three stories in height and 110x45 feet in dimensions. Col. Simeon J. Fox, treasurer and manager of the company, expects the building to be completed for occupancy about December 1, and is deservedly proud of it.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., is very busy at the present time, working its full force up to 9 o'clock at night, to keep up with its orders. The success of this company is a handsome tribute to the energies of Mr. W. C. Bryant and President Eaton, and considerable credit is also due to Mr. H. A. Hubbell, its cashier and book-keeper, who by his knowledge of the business is able to aid Messrs. Bryant and Eaton and creditably represent them during their absence.

THE NEW HAVEN CAR REGISTER COMPANY, of New Haven, Conn., was the recipient of an unusually large number of orders for its fare registers during the recent Street Railway Convention in Atlanta, Ga., at which it had a splendid exhibit. Mr. F. C. Boyd, vice-president and general manager, and Mr. John S. Bradley, secretary and treasurer of the company, both of whom were in attendance at the convention, are, of course, greatly pleased over the kindly tributes paid their registers by street railway officials and the business recognition it received.

THE PERKINS ELECTRIC SWITCH & MANUFACTURING COMPANY'S new building on Woodbine street, Hartford, Conn., is about completed, and Mr. Perkins expects it to be ready for occupancy shortly after November 1. Mr. Perkins regards his new building with considerable pride, and well he may, for it is certainly a handsome structure. It is three stories in height with an L attached to the main building, which in dimensions is 148x42 feet, the L being 35x50 feet. There are nearly 25,000 square feet of floor space in the building. Abundance of light is afforded in the building throughout, and so far as general appointments are concerned it is most admirably adapted for manufacturing purposes, Mr. Perkins having superintended himself almost every detail of its construction. It is a worthy home for Mr. Perkins' already large and rapidly growing business. Mr. Perkins has considerable ground space adjoining his new factory, and proposes to commence at once the erection of two new buildings one 30x15 feet and the other 20x25 feet.

THE FRISBIE ELEVATOR & MANUFACTURING COMPANY, of New Haven, Conn., is about ready to introduce to the public its new machine for electric elevator purposes, upon which Mr. Frisbie has been busily engaged for some time. It certainly possesses extraordinary merits and advantages, and is a wonderful improvement over its old design of a continuous running motor in one direction. Briefly, its principal features are: That by an ingenious combination of screws and gears the transmission of power to the drum is reversed at the will of the elevator operator; an automatic stop motion renders it impossible for the elevator to travel beyond the top and bottom limits of the well hole; the current required is slight and the machinery runs with very little friction; it operates an elevator with an entire absence of vibration, the starting and stopping being very smooth and gradual, and without any of the unpleasant sensations or jarring so often experienced on high-speed elevators; the elevator, by means of a lever, can be operated with such nicety that it can be started either up or down and stopped or reversed within the space of an inch. While riding in the elevator with Mr. Frisbie he was observed to make a considerable number of rapid reversions of the lever from one extreme to another, the car virtually dancing in the air within the space of about six inches, without any injury to the machine or excessive use of the current. The machine was also made to lift the elevator with one person of nearly two hundred pounds weight to a height of fourteen feet, after the current had been cut out of the motor, the car continuing to run between thirty-five and forty seconds, thus showing the very small percentage of friction on the various parts. These are only a few of the important features of the machine, but enough certainly to demonstrate the exceptional advantages it possesses. Mr. Frisbie uses in connection with his machine the Crescent motor, manufactured by the Crescent Electric Machine Company, of Brooklyn, N. Y., which he regards as particularly adapted for elevator work.

CANADIAN NOTES.

OTTAWA, Oct. 25, 1894.

HAMILTON, ONT.—An electric railway between Hamilton and Guelph is proposed.

HAMILTON.—The formal opening of the Hamilton, Grinsby and Beamsville electric railway has taken place.

SEAFORTH, ONT.—A charter has been issued to the Seaforth Electric Light, Heat and Power Co., with a capital of $25,000, for general electric purposes.

OTTAWA.—The Government steamer Newfield has been placed at the disposal of the Government cable superintendent, D. H. Keeley, who will commence repairs to the cables between Grand Manan, Campobello and Eastport.

MAGOG.—The town of Magog, Que., has entered into a contract with Mr. Le May to supply arc and incandescent lights for a period of five years. The price for arc lights is $55 per year; for sixteen-candle power incandescent lamps, $5; and for 32-cp lamps $10.

AYLMER, QUE.—This town will shortly be lighted by electricity. R. & W. Conroy have contracted with Messrs. Ahearn & Soper, of this city, for the necessary dynamos, wire, etc. The work of erecting the lines and wiring houses is being done by R. Anderson, electrician, of Ottawa.

OTTAWA.—The Government advertisement calling for tenders for the proposed Pacific cable is attracting outside attention. Mr. T. G. Blackstock is here representing two cable manufacturing companies, one French and the other English, which purpose putting in tenders for constructing the cable.

HULL, QUE.—Theohile Viau, contractor; Jacques P. DeMartigny, banker; Stanislaus Aubry, millwright, of Hull; Charles L. DeMartigny, of St. Jerome; and Alexander Bourgeau, capitalist, of Montreal, are applying to the legislature for an act incorporating them under the name of the Hull Electric Company, with a capital stock of $25,000.

AYLMER, QUE.—T. Viau, contractor of Hull, acting as representative of a private company, with a stated capital of a quarter of a million dollars, has proposed to the Aylmer Town Council a scheme whereby Ottawa and Aylmer are to be connected by electric railway. The company want a bonus of $10,000 and thirty-five years' exemption from taxation.

News of the Week.

TELEGRAPH AND TELEPHONE.

KNOXVILLE, TENN.—The People's Telephone Company is making rapid progress in its construction work, under the managmement of Mr. J. C. Duncan. A six hundred-wire switch board and four hundred telephones have been ordered, and 30,000 pounds of wire have been received.

UNIONTOWN, PA.—A charter was granted to the Home Telephone Company, Uniontown, Pa., to maintain and operate a telephone line from Uniontown to Scottdale, to New Haven, etc. The directors are William C. McCormick, Albert Inks, O. J. Sturgis, John K. Ewing, Jr., all of Uniontown, and others.

ELECTRIC LIGHT AND POWER.

HARRISONVILLE, MO.—An electric plant will be established here.

ST. ALBANS, W. VA.—Dana Brothers have put in an electric chain apparatus in their mines.

HONESDALE, PA.—The Honesdale Electric Light, Heat & Power Company's plant will be enlarged.

SPRINGFIELD, MASS.—A forty-foot addition is being built by the electric plant owners at Indian Orchard to accommodate the machinery for an additional 350 lights which are to be put in.

DUNKIRK, IND.—Dunkirk has granted an electric light franchise. The plant is to be completed within 90 days.

DULUTH, MINN.—The Duluth Heights citizens have presented a petition asking for the erection of an electric light plant.

ELON COLLEGE, N. C.—Holt, Gant & Holt are in the market for an incandescent electric light plant of 300 lights of 16-cp each.

DAWSON, GA.—The City Council has ordered an election for November 14, to decide as to issuing $35,000 in bonds to build an electric light plant and waterworks.

BUFFALO, N. Y.—A petition from the Niagara Falls Power Company asking a grant to wire the city for the distribution of electric power, was transmitted to the Board of Aldermen.

HUNTINGTON, N. Y.—The Huntington Town Board has been petitioned to create a street lighting district in the village of Huntington. The Board will take action upon the petition Oct. 28.

BELOIT, WIS.—G. L. Call, proprietor of the Beloit Electric Light plant, has been granted a franchise by the Common Council for the construction and maintenance of a telephone exchange.

EVERETT, MASS.—The Everett Aldermen appointed Aldermen Dyer, Cate and Jennings members of the joint special committee to investigate the report on the feasibility of establishing a municipal electric light plant.

NEWTON, MASS.—It is proposed to put the matter of municipal electric light before the citizens of Newton for a decision at the coming city election. If it receives an endorsement at the polls, immediate steps will be taken to secure a plant.

WEST UNION, IOWA.—The vote on the proposition to issue bonds for electric lights was carried almost unanimously. The City Council is looking into the merits of the various plans, and hopes to have everything in shape so that work on the construction can be commenced in a few weeks.

DENVER, COL.—At the meeting of the County Commissioners the Board discussed the lighting of the Court-House, and a committee of three, consisting of Commissioners Nicholl, Kratzer and Wheeler, was appointed to consider the advisability of putting in a large dynamo to relieve the pressure upon the large dynamo now in use lighting the Court-House.

CAPE MAY, N. J.—Supt. James E. Taylor, of the Franklin Electric Light Company, who is also general manager of the South Jersey Railroad, announces that work will be commenced immediately on a $50,000 plant which is to support incandescent as well as arc lights. In the company are Logan M. Bullitt and Thos. Robb, of Philadelphia, Mayor Hildreth and ex-Mayor F. J. Melvin.

BRIDGETON, N. J.—The Light Committee of the city of Bridgeton will receive bids for the lighting of the streets of the city of Bridgeton for a period of five years, from the 13th of December, 1894. Bids must be handed in by noon, October 31. All bids are to be sealed and to be addressed "Bids for Lighting Streets of the City of Bridgeton," and to be sent to Stacy W. Matthews, 72 Pine street, Bridgeton, N. J.

THE ELECTRIC RAILWAY.

POTTSVILLE, PA.—The Schuylkill Electric Railway Company has been granted permission to extend its lines.

SOUTH FRAMINGHAM, MASS.—The Union Street Railway Company will probably equip its line with electricity.

SCOTCH PLAINS, N. J.—The ordinance has been presented giving the trolley company a franchise to operate a trolley road through the township.

BALTIMORE MD.—Efforts are being made to induce the Baltimore City Passenger Railway Company to extend its electrical line to Westport.

ROCKVILLE, CONN.—The Rockville & Ellington Railway Company is trying to secure a privilege to build its road to the town line beyond Talcottville.

NEWBERRY, FLA—The Victoria Phosphate Company contemplates operating its railroad by electricity. Address J. A. Little, president, at Jacksonville, Fla.

JACKSON, TENN.—The Jackson & Suburban Railway Company, J. H. Hunter, president, will probably soon begin the construction of its electric railroad.

BALLSTON SPA, N. Y.—The Milton Highway Commissioners will meet to consider the granting of a franchise for the Ballston & Rock City Falls Electric Railway.

MINER'S MILLS PA.—The Traction Company surveyors are looking over a proposed route through Main street, of Miner's Mills, to extend to Mill Creek by way of the Bennett colliery.

GRAND ISLAND, N. Y.—It is said that the proposed electric railway around Grand Island will probably be built. Mr. John J. McIntyre, of Niagara Falls, can probably give some information.

NORRISTOWN, PA.—Officers of the Norristown & Chestnut Hill Passenger Electric Railway are in town arranging with the Council for the immediate construction of its line in this borough.

HAMBURG, PA.—The Pottsville & Reading Railway Company has received the right to build and operate an electric railway on certain streets in the borough of Hamburg, County of Berks.

SYRACUSE, N. Y.—The power house of the Syracuse Street Railroad Company will be located on Tracy street in the Third ward. James Stewart & Co. are the contractors. It will cost about $40,000.

A CORRECTION.—In the second line of the fifth paragraph of the paper of Mr. Russell B. Harrison, published in our last issue, a typographical error made "metal cross ties" read "metal glass ties."

WATERTOWN, N. Y.—The street railway company of Watertown proposes to extend its electric road from Brownville to the village of Dexter. The proposed extension is three miles long, and to cost $30,000.

WESTBORO, MASS.—The proposed electric road between Marlboro and that town will run near Lake Chauncey and the hospital. From Westboro another road is proposed to Woodville and Hopkinton.

FAIRFIELD, CONN.—The Selectmen of Fairfield and the officials of the Bridgeport Traction Company have practically agreed on the specifications to be observed in the building of the trolley line to Southport.

PORT HOPE, ONT.—At the request of ex-Mayor Randall, the Council endorsed the report of last year's Council granting the promoters of the electric railway the use of the streets of the town on certain conditions.

BATAVIA, N. Y.—James H. Ahern of New York City, a promoter of street railways was in town endeavoring to interest Batavia citizens in the project of building a trolley road to run from Batavia to Le Roy, the cost to be $200,000.

MOUNT VERNON, N. Y.—The Mount Vernon Common Council has given the Union Electric Railway Company permission to lay double tracks through First street in that city, from Scott's bridge to the terminus at Third avenue.

COWLESVILLE, N. Y.—A trolley line is proposed from Cowlesville to Marilla. A committee appointed to solicit funds are Hon. A. H. Haskins, Charles Hart, W. T. Martin, T. Austin, Grove Barnum, of Cowlesville, and others of the borough.

ORANGE, N. J.—The trustees of the village of South Orange passed the ordinance granting a franchise for an electric railroad from South Orange avenue to the West Orange line to the South Orange & Maplewood Street Railway Company.

AMITYVILLE, N. Y.—South Norwalk capitalists stand ready to build and operate an electric railway across Long Island. Huntington and Amityville will be connected. Mr. Stephen R. Williams, of Amityville, can probably give information.

NIAGARA FALLS, N. Y.—A local paper stated that the contract for building the proposed electric railway to Tonawanda from this city has been let to Sims & Co., and that work would begin immediately. Frank A. Dudley is one of the projectors.

MT. VERNON, O.—The Central Ohio Electric Railway Company has been granted the right of way on the highways of Knox, Morrow and Marion counties, and they are to be connected by an electric railway if the project commenced is carried to completion.

NORRISTOWN, PA.—The Philadelphia & Rosemont Electric Railway Company is acquiring a right-of-way from Philadelphia to Bridgeport. The company desires a franchise over certain streets in Bridgeport, and the matter is in the hands of a committee of Council.

CLARKSBORO, N. J.—A number of men interested in the extension of electric transit in the lower portion of Gloucester county met and temporarily organized a company to build a road from this city to Swedesboro, etc. John S. Somers of Clarksboro, acted as president.

SYRACUSE, N. Y.—Three petitions for street railway franchises from the Syracuse Street Railway Company, the Twelfth Ward Street Railway Company and the Syracuse & East Side Railway Company, were presented to the Common Council and referred to the Highway Committee.

NEW BEDFORD, MASS.—The "Standard" reports that F. S. Stevens, R. T. Davis, Frank Brightman, W. F. Thomas and Benjamin Cook have petitioned for a charter for the Fall River & Providence Street Railway Company, with all of the rights and privileges for building and operating an electric road.

HIGHLAND PARK, MICH.—The Common Council of the village of Highland Park, Wayne county, Mich., on October 15 confirmed an ordinance granting to W. Howie Muir, of Detroit, a franchise to construct an elctric railway, about two and a half miles long, to be completed and running within twelve months.

BOWLING GREEN, OHIO.—The Council has decided to receive bids for an electric railway franchise within the city limits. E. H. McKnight has made application for the franchise, but it is thought that several other bids will be presented, as other parties are figuring on building an electric road to Perrysburg.

NEWTON CENTER, MASS.—People of Newton Centre met in answer to a call issued by the Newton Center Improvement Association, to connect several routes proposed for street car lines to connect the village of Newton Centre with the Central Boulevard. After considerable discussion it was voted to postpone the consideration of the question.

DETROIT, MICH.—On October 15 the Common Council of Detroit granted a permission to the Detroit Citizens' Street Railway Company to build a temporary single track electric railway from Pallister avenue north to the city limits on Woodward avenue, on the condition that it completes a double track road with girder grooved rails by July 1, next.

ORANGE, N. J.—Mr. F. H. Tidman, formerly of the Edison and Westinghouse companies, has taken charge as superintendent and consulting engineer of the road of the Suburban Traction Company. The company is about to build four miles of overhead pole line, and offers will be considered for hexagonal wood poles, iron poles and about a mile of No. 4-0 feeder wire.

GLOUCESTER, MASS.—The Board of Aldermen met and gave a hearing to the syndicate of capitalists who are planning extensive street railway building in Essex county and on Cape Ann. The petition of the Gloucester & Beverly Street Railway Company for a location (W. B. Ferguson, president of the syndicate) said that the company proposed to run to the Salem line.

WOODBURY, N. J.—A number of men interested in the extension of electric transit in the lower part of Gloucester county met and temporarily organized a company to build a road from Woodbury to Swedesboro, and from Mullica Hill to the Delaware river, etc. John S. Somers, of Clarksboro, acted as president, and James J. Davidson as secretary. Permanent organization will be effected at a second meeting.

LEWISTON, N. Y.—A company, of which Capt. John M. Brinker, of this city is the president, is getting the right-of-way for a double track electric road to be built along the gorge on the American side of the Niagara river, between Niagara Falls and Lewiston. H. Sellers McKee, of Pittsburg, is vice-president of the company, and R. W. Jones, Mr. Brinker's partner in the coal business, is secretary and treasurer.

SAGINAW, MICH.—The project to connect Saginaw and Bay City by an electiric railway is under discussion. E. A. Snow, of Detroit, president of the Saginaw Union Street Railway Company, and W. J. Hart, manager of the road, held a conference with the president and manager of the Bay City Consolidated Street Railway in regard to furnishing power and local terminal facilities for the electric road which is to connect the two cities.

CORTLAND, N. Y.,—The Cortland & Homer Traction Company has purchased the equipment for its entire steam plant. Specifications were drawn and contracts placed under the direction of Prof. R. C. Carpenter, of Cornell University. The company will put in four compound condensing Watertown engines, with pumps, condensers, heaters and four 100-hp boilers manufactured by the Watertown Steam Engine Company, of Watertown, N. Y.

BOWLING GREEN, OHIO.—A plan is now on foot to build an electric line between Bowling Green and Perryburg. E. H. McKnight, of Bowling Green, one of the principal owners of the lighting plant at Bowling Green, is back of the scheme. He has recently disposed of a road to Troy, Ohio, and now contemplates connecting Perryburg and Bowling Green. He has secured the right-of-way, with perhaps one exception, between the two towns, and has asked the councils of both towns to grant a franchise.

JOLIET, ILL.—R. B. Campbell, general manager of the Baltimore & Ohio, Baltimore; J. W. Fortune, assistant general manager of the Grand Trunk, and A. J. Green, of Windsor, Ont., were in Joliet looking for investments for the Baltimore & Ohio road. They are taking particular interest in the Joliet Street Railway Company and the Economy Light & Power Company. The probabilities are that the electric street car system will be extended from Lockport to Chicago. The Joliet system will be overhauled at an expense of $60,000. The electric light plant will also be enlarged.

PERSONAL NOTES.

MR. F. S. KENFIELD, of the Street Railway Review, Chicago, was married on Wednesday, October 24, to Miss Amy Sweeney, of Rock Island, Ill. The many friends of the happy couple will join The Electrical World in extending congratulations and good wishes.

THE ENGINEERING PROFESSION of the Pacific Slope is to be congratulated upon the entrance into its ranks of the new engineering firm of Hasson & Hunt, electrical and mechanical engineers. Both of the members of the firm are thoroughly accomplished engineers, not only by education but also through the possession of a wide and varied engineering experience. Mentally they are endowed with the broad caliber and sound judgment characteristic of the higher order of engineering ability, and thus in every respect are thoroughly equipped to successfully undertake the most difficult engineering problems that may come before them. Mr. W. F. C. Hasson, the senior member of the firm, was graduated from Woodward College, of Cincinnati, as gold medallist in 1876, and the same year entered the United States Naval Academy as a cadet engineer. During the course at the Naval Academy Mr. Hasson enjoyed the enviable distinction of being a "star" member of his class, the name being derived from a gold-embroidered star worn on the collar of uniforms, this honor being conferred by the academy authorities for brilliant class standing. Upon graduation Mr. Hasson was ordered to the Asiatic station and at the end of the cruise was detailed for a three-years tour of duty at Colorado University as professor of engineering. At the expiration of this detail he entered upon another tour of naval duty, the trip extending around the world with a lengthy service in Asiatic waters. Upon his return to the United States in 1888 Mr. Hasson was detailed by the Navy Department as an instructor in the electrical engineering course of Johns Hopkins University, and two years later was ordered to San Francisco as an inspector of machinery of the new men-of-war being built there. In 1893 he resigned from the naval service and began the practice of his profession in civil life at San Francisco. Mr. A. M. Hunt, the junior member of the firm, is also a graduate of high standing from the engineering course of the Naval Academy, and, like Mr. Hasson, was highly regarded in the naval service for his professional accomplishments. The intervals between his sea service were mostly spent on special duty, which included one college detail as a professor of engineering. The Navy Department also availed itself of the skill of Mr. Hunt as an expert in steel, and much of his time ashore was spent on duty connected with the inspection of material for men-of-war in course of construction, and in work in the designing branch. When work on the mid-winter fair was begun Mr. Hunt was detailed by the Navy Department to take charge of the mechanical engineering department, where he made a most enviable reputation and, upon the closing of the fair, resigned from the naval service to enter into partnership with Mr. Hasson. The work of Messrs. Hasson and Hunt in connection with the mid-winter fair gave evidence of not only fine engineering ability but of unusual executive talent. The entire execution of the electrical and mechanical portion was left with Mr. Hasson as chief engineer and, with the assistance of Mr. Hunt, the result produced was little short of marvellous when the extraordinary difficulties are considered. The success was entirely a personal one, the large equipment required being obtained by personal solicitation from every imaginable source. Every sort of engineering expedient had to be devised in order to fit the heterogenous assortment of apparatus to each other and the end in view and make the odd combinations serve the desired purpose, and this with an inadequate force of men, restricted funds and an extremely limited time in which to complete the work. Notwithstanding all these discouraging features, on opening day the electrical department was the only complete one of the Fair, and its excellent operation throughout was one of the largest factors in the great success of the exhibition.

W. F. C. HASSON.

A. M. HUNT.

MISCELLANEOUS NOTES.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION has confirmed the action of the Executive Committee at a meeting held in New York September 11, in selecting Cleveland as the place for holding the next convention, on February 19, 20 and 21, 1895.

COMBINATION FIXTURE LITIGATION.—Judge Acheson, of the United States Circuit Court of Appeals, sitting in Philadelphia, on October 22, rendered a decision in favor of the Gibson Gas Fixture Works against George Maitland, the plaintiff in the case. The plaintiff claimed that through two letters patent granted to Luther Stieringer, of whom he was the assignee, for what are called combination fixtures, in which gas and electricity are both used for lighting, he had the monopoly of hanging an electric light on a fixture attached to a gas pipe, whether the fixture was used simply for an electric light or whether it was used for electric light and gas. The patentee claimed he had made an invention by running wires down through the ordinary gas pipe in a fixture used simply for electric lights, or between the iron pipe and the brass casing where the fixture was used both for gas and electricity.

GERMAN INCANDESCENT LAMPS.—The Marinette, Wis., "Eagle" says that the manager of the Wright Lumber Company at Merrill, Mr. H. W. Wright, was recently solicited by an agent of a German house, who offered to deliver incandescent lamps in Merrill at a price eight cents apiece less than Mr. Wright could buy them for anywhere in the United States and pay his own freight. The "Eagle" becomes somewhat excited over this intelligence, and demands that a duty of eight cents be placed on foreign lamps to prevent American manufacturers of lamps from closing their works or reducing wages to a level with those of Germany.

Trade and Industrial Notes.

FOWLER & M'VITIE, of Galveston, Tex., have established a branch at Tampico, Mexico, with Mr. Howard Carnes in charge.

THE STAR DYNAMO COMPANY, Jefferson, Mo., has issued a catalogue describing and illustrating the Star dynamo. This machine is designed especially for use in isolated and private plants, and with a special view to wearing qualities.

THE BROWN & SHARPE COMPANY, Providence, R. I., in a recent pamphlet gives a number of excellent half-tone illustrations, printed upon a fine quality of wood-cut paper, of cutters, mostly special patterns. From the introduction we learn that this firm manufactures no less than eight hundred and forty-nine sizes of stock cutters.

THE LOUISVILLE ELECTRICAL WORKS, Louisville, Ky., has recently been giving considerable attention to the manufacture and sale of patented inventions. This branch of its business is growing with gratifying rapidity and with the anticipated revival in business in the West will undoubtedly reach large proportions.

W. H. HORNBERGER, Elkhart, Ind., has sold his entire interest—including patents—in the Hornberger Electric Manufacturing Company to Mr. J. C. Boss. Mr. Hornberger founded the above company nearly five years ago, and by keen business sagacity and the determination to manufacture a transformer of high merit, soon placed his company in the front rank of electrical manufacturers.

THE MICHIGAN ELECTRIC COMPANY, 47 State street, Detroit, Mich., illustrates and describes in a 22-page catalogue the well-known "Michigan", electric railway specialties. All of these fittings have been designed by men who have been continuously engaged in the construction and operation of electric railways since 1888, and therefore specially fitted from their practical knowledge for the work.

THE C. W. HUNT COMPANY, 45 Broadway, New York, has issued a handsomely illustrated and printed catalogue under the title of "Coal Handling in Power Stations," in which many equipments for this purpose are shown and described. The pamphlet has largely the character of a technical treatise on the subject, and will be found of much interest by engineers and power-house and central station managers.

CHARLES A. SCHIEREN & CO., 45 Ferry street, New York, have received a letter from electrical engineer, Alfredo De Rosenzweig, of Guanajuato, Mexico, under date of October 12, reading as follows: "In November or December, 1893, I bought five perforated electric leather belts from you, each fifteen inches wide, for an electric plant of this city. These belts are giving excellent satisfaction, and I know of no better class of belting for use in electric light work."

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., reports the outlook as encouraging. It has recently shipped its dynamos and motors to Louisville, Ky.; Jeffersonville, Ind.; Dallas, Tex.; Elgin, Ill.; Dayton, O., and Cleveland, O., besides several plants sold and erected in Cincinnati. Its plant is running full time and inquiries are coming in very fast. The general public are becoming more familiar with the many excellent features embraced in The Triumph design.

THOMAS H. FOOTE, for the past four years connected with the Waddell-Entz Company, has opened an office as consulting electrical engineer in Harlem, No. 215 W. 125th street. Mr. Foote will make a specialty of installing isolated plants, electrical testing, etc. Previous to his connection with the Waddell-Entz Company, he was with the Edison Company, at Schenectady, for three years, and was superintendent of their testing room for some time The last year and a half he was superintendent of the storage battery plant at Second avenue in this city, for the Waddell-Entz Company

THE MIAMISBURG ELECTRIC COMPANY, Miamisburg, Ohio, has evidence of return to better times by the numerous orders it is receiving in tempered copper and its celebrated batteries. The demand for the Imperial Dry Battery is increasing, so that it is with great effort able to supply the sudden increased demand. The electrical trade is finding out that the Imperial has stood the test of the trade and scientific experts for the past two years, and the company challenges the world to produce its equal. Its tempered copper is securing a reputation second to none on the market. It will shortly introduce to the trade something entirly new in this line.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., reports that among recent orders received for its pressure regulators to be applied to dynamo engines are two four-inch for the United States battle ship "Texas"; one five-inch for the United States armored cruiser 'Brooklyn"; one three-inch and one four-inch for the United States armored cruiser "Indiana"; five seven-inch for the Providence Steam Engine Company; two eight-inch for the Corliss Engine Company, of Providence and one four-inch for the Western Union Telegraph Company's building. The latter is to deliver steam to three dynamo engines, and to meet specifications is required to maintain within one pound a uniform delivery pressure of 45 lbs. regardless of change of initial or boiler pressure, which ranges from 60 to 100 lbs., and regardless of change of load or number of engines in operation.

Business Notices

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs, doing business at Rochester, N. Y., has been mutually dissolved.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 23, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

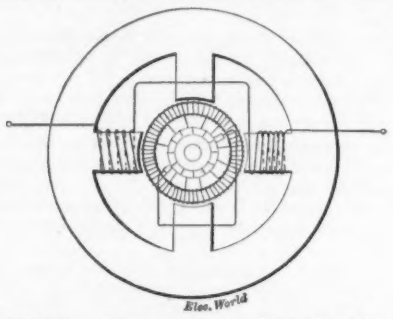
527,766. METAL BRUSH FOR DYNAMOS; W. Von Braucke, Thmerterbach, Germany. Application filed July 2, 1894. This consists of a large number of thin threads of copper laid loosely side by side and held together by a metal wire cloth.

527,776. ELECTRIC MOTOR OR DYNAMO; C. P. Daniels, Macon, Ga. Application filed Dec. 2, 1891. This comprises field magnets separate and independent of each other, each magnet consisting of two parts connected by curved and angular bars.

527,785. RAIL BOND; W. A. Granten, Hartford Conn. Application filed June 7, 1894. This consists of a body having a threaded shank with a hollow end, and a plurality of wire grooves, the outer walls of the grooves being formed by outward extending ears, and a bonding wire grapped by the ears.

527,786. SELF-WINDING ELECTRIC CLOCK; E. G. Hammer, Brooklyn, N. Y. Application filed July 13, 1893. This comprises a circuit-closer consisting of two vertically sliding pins one above the other, normally our of contact, and a mechanism in connection with the clock movement for lifting the lower pin into contact with and to lift the upper pin.

527,788. ELECTRIC UTERINE BATTERY; C. E. Hebard, Grand Rapids, Mich. Application filed July 11, 1894. This comprises an inner perforated tube,



No. 528,121.—Alternating Current Motor.

a solid outer tube, a zinc head for one tube and a silver flange at the other end thereof, and the two conneted by a copper ribbon.

527,823. CLOSED CONDUIT ELECTRIC RAILWAY; J. F. McLaughlin, Philadelphia, Pa. Application filed April 5, 1894. This comprises a travelling magnet above the conduit, a circuit closing trolley in the conduit carrying an armature for the magnet, and lugs in the conduit between the magnet and armature and constituting stationaty polar extensions of the magnet.

527,857. TRANSFORMER SYSTEM FOR ELECTRIC RAILWAYS; M. Hutin and M. Leblanc, Paris, France. Application filed Nov. 16, 1892. The combination with the vehicle, of a stationary primary circuit extending longitudinally and carrying alternating currents of high frequency, and a secondary circuit carried on the vehicle and including a secondary coil, and means for suppressing the self-induction of said coil.

527,839. ANNUNCIATOR SIGNAL; I. H. Farnham, Wellesley, Mass. Application filed Feb. 23, 1894. This comprises an auxiliary circuit, a periodic interrupter therefor, a series of circuit closers, and an auxiliary signal device included in the auxiliary circuit and requiring for its operation the concurrent action of the periodic interrupter and some one of the circuit closers.

527,840. SUPPORT FOR TROLLEY WIRES; F. C. Fisk, Buffalo, N. Y. Application filed March 1, 1894. This consists of twin parts having similar inclined grooves which register with each other to form an inclined passage, and a sleeve adapted to surround and carry the line wire and provided with inclined flanged wings adapted when brought together for sliding and wedging engagement with the inclined passage.

527,861. METHOD OF MANUFACTURING ELEMENTS OR PLATES FOR SECONDARY BATTERIES; H. F. Kirkpatrick-Pickard & H. Thame, London, England. Application filed Jan. 10, 1894. This consists of melting separately galena and metallic lead, mixing the same and pouring the mixture in a molten condition into a heated metallic mold.

527,864 CARBON HOLDER FOR ARC LAMPS; E. Lavens, Brooklyn, N. Y. Application filed March 17, 1894. This comprises two plates having angular portions and fitted together so as to be capable of sliding lengthwise relatively thereto, and means for adjusting the plates relatively to each other.

527,874. CLOSED CONDUIT ELECTRIC RAILWAY; J. F. McLaughlin, Philadelphia, Pa. Application filed May 24, 1894. This comprises electro-magnets hung from a motor car and free to tilt and to swivel in a horizontal plane.

527,901. ELECTRIC ARC LAMP; H. O. Swoboda, New York, N. Y. Application filed March 2, 1894. This comprises a movable carbon support, a controlling device, a solenoid, a tilting frame connected with the core of the solenoid, mechanism carried by the tilting frame and connected with said controlling device, a pin pivotally connected with the balance lever, a spring for holding the pin in normal position and a projecting pin supported by a stationary part of the lamp for co-acting with said pin of the balance lever.

527,920. TROLLEY WIRE SUPPORT; M. M. Wood, Chicago, Ill. Application filed April 30, 1894. The combination of a bracket arm provided with a hook at one end and a span wire support at the other end.

527,927. ELECTRIC MOTOR FOR RAILWAY CARS; N. C. Bassett, Lynn, Mass. Application filed June 28, 1893. An electric motor geared to and centered upon a car axle, and supported upon a supplementary frame pivotally connected at one end of the truck, and spring supported at the other end.

527,958. ELECTRIC SIGNALING SYSTEM; B. A. Fiske, U. S. Navy. Application filed May 13, 1892. This comprises a transmitting instrument containing a cylinder, circuit head, pivoted arm thereon provided with a contact point, conductor, supported on the periphery of the head and insulated therefrom, and an electrical indicating instrument within the cylinder, the cylinder having an opening through which the instrument may be seen.

527,947. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC CARS; H. P. Davis, Pittsburg, Pa. Application filed March 29, 1894. This consists in connecting two motors on the car in series, cutting out one of the motors, connecting the two in parallel with resistances and diminishing the resistances in series with the two motors successively, the resistance in series with the motor previously cut out being the first cut out.

527,989. COMBINED REGULATING INCANDESCENT LAMP AND SOCKET; C. A. Hussey, New York, N. Y. Application filed May 14, 1894. This comprises two filaments having their ends joined in a common terminal at one side, and disconnected and insulated terminals at the other side, a circuit controller having a pair of normally open spring contacts in circuit respectively with the insullated filament terminals, other spring contacts in circuit respectively with the common and one of the insulated terminals, and a rotary contact piece carrying a cam adapted to connect the filaments in series, singly, or in multiple, with the circuit mains.

528,014. ELECTRIC SWITCH; J. F. McLaughlin, Philadelphia, Pa. Application filed May 6, 1893. This comprises a rotary spring actuated switch block, a lock for holding the block against the action of the spring, and a winding key for the spring.

528,021. ELECTRIC LIGHTING SYSTEM; G. T. & G. J. T. J. Parfitt, Keynsham, England. Application filed July 12, 1892. In a multiple series circuit, each of the branches of the main lines having a separate electro-magnet and light connected in series, and each of the branches having a resistance circuit around the lamp, and each of the magnets adapted for operating a switch to bring the resistance into multiple with the lamp circuit when an excess of current passes through it, and to break the resistance circuit when the lamp circuit is broken, or when no excess of current passes through the lamp circuit.

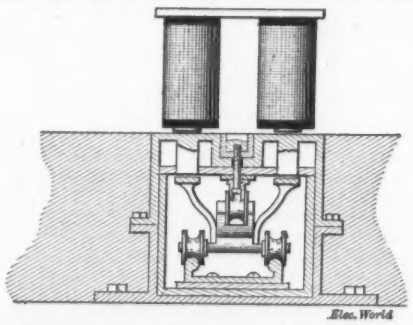
528,040. TELEHPONE CIRCUIT AND SIGNAL; T. Spencer, Cambridge, Mass. Application filed Nov. 18, 1893. The combination of the two conductors of a link connection, a source of current in a bridge between them, and an induction coil having its two windings interposed in one of the conductors on different sides of the junction of the bridge, and an automatic annunciator or other visual signal in a shunt circuit round one of the induction coil helices.

528,053. MAGNETIC SEPARATING MACHINE; W. H. Williams, Newark, N. J. Application filed June 27, 1891. The combination with a pair of magneto-electric poles arranged pole to pole, of a non-magnetic drum rotating within the magnetic field between the poles.

528,054. MAGNETIC SEPARATOR; W. H. Williams, Newark, N. J. Appplication filed Jan. 29, 1892. The combination of two cores and helices arranged end to end with their poles adjacent, and a yoke joining the cores and central thereto.

528,075. COMBINED TELEPHONIC AND SIGNALING SYSTEM; H. A. Chase, Boston, Mass. Application filed June 25, 1894. This comprises a main line circuit with transmitting and receiving devices, a shunt circuit around a controller for said main line circuit, a telephonic apparatus in the shunt circuit under control of the main line circuit controller, and a second telephonic apparatus as the receiving station under control of a circuit controller at said receiving station.

528,101. TROLLEY WIRE SWITCH PLATE; G. A. Huben, Springfield, O. Application filed Feb. 23, 1894. The combination of a metallic frame having



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an enlarged opening, and a trolley wire entering the same, and elastic cushions arranged on each side of the trolley wire.

528,119. ELECTRIC ARC LAMP; S. Bergmann, New York, N. Y. Application filed April 6, 1894. The combination of a movable carbon support, a notched wheel deriving motion therefrom, and a contact piece bearing against the wheel and caused to shift its position by the notch of the wheel.

528,121. ATERNATING CURRENT MOTOR; C. T. Child, Ashland Va. Application filed Dec. 22, 1893. An alternating current motor consisting of secondary coils in close relation to masses of iron between the alternating and opposite poles of the field magnet, to reduce the current in the armature coils by the alternating current in the field coils.

528,122. AUXILIARY SIGNALING SYSTEM FOR RAILWAYS; M. S. Conly, Chicago, Ill. Application filed March 6, 1890. This comprises a series of stationary signals in circuit, a primary coil in the circuit, a secondary coil and circuit carried by the engine, a battery and signal also carried on the engine, the battery being arranged to operate the signaling device upon the passage of the secondary coil through the magnetic field of the primary coil of the track signal.